4-14-1982

United States' Proposed Findings

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IN THE DISTRICT COURT OF THE

FIFTH JUDICIAL DISTRICT

STATE OF WYOMING

IN RE: THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING	)	CIVIL NO. 4993

UNITED STATES' PROPOSED FINDINGS OF FACT, CONCLUSIONS OF LAW, BRIEF IN SUPPORT THEREOF, AND PROPOSED INTERLOCUTORY DECREE

FILED 4993

4/14 1982

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DEPUTY

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IN THE DISTRICT COURT OF THE

FIFTH JUDICIAL DISTRICT

STATE OF WYOMING

IN RE: THE GENERAL ADJUDICATION OF ALL RIGHT TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING	Civil No. 4993

UNITED STATES' PROPOSED FINDINGS OF FACT

I. ADJUDICATED ACREAGE CLAIM FINDING

1. There are 17,411 acres held in trust by the United States on which the State of Wyoming has granted a state certificate of appropriation or an "adjudicated water right". The trust acreage and the corresponding permit number, proof number, photo number, ditch name and tract number are as follows:

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
6633-9080	18593	13-104	Ray Canal	1-1C	7.9
6633-9080	18424	13-104	Ray Canal	1-2C	10.0
6633-9080	18423	14-67	Ray Canal	1-3C	74.5
6633-9080	18596	14-69	Ray Canal	1-4C	63.4
6633-9080	20248	15-21	Ray Canal	$1\text{-}5C_1$	141.0
6633-9080	20248	15-21	Ray Canal	$1\text{-}5C_2$	30.0
6633-9080	18587	15-21	Ray Canal	1-6C	20.0
				TOTAL	346.8
6632	18573	15-23	Coolidge Canal	2-1C	24.0
6632	13587	15-25	Coolidge Canal	2-2C	36.0
6632	18414	15-25	Coolidge Canal	2-3C	59.2
6632	18417	15-25	Coolidge Canal	2-4C	40.0
6632	18572	15-25	Coolidge Canal	2-5C	20.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
6632	18575	15-25	Coolidge Canal	2-6C$_1$	40.0
6632	18575	15-25	Coolidge Canal	2-6C$_2$	40.0
6632	18576	15-25	Coolidge Canal	2-7C$_1$	10.0
6632	18576	15-25	Coolidge Canal	2-7C$_2$	40.0
6632	19141	15-25	Coolidge Canal	2-8C	2.0
				TOTAL	311.2
6628	18400	10-200	Meadow Creek Bench Canal	5M-1C	40.0
6628	16412	10-200	Meadow Creek Bench Canal	5M-2C	115.0
6628	18399	10-200	Meadow Creek Bench Canal	5M-3C$_1$	35.0
6628	18399	10-200	Meadow Creek Bench Canal	5M-3C$_2$	10.0
6628	18399	11-170	Meadow Creek Bench Canal	5M-3C$_3$	7.0
6628	18913	10-202	Meadow Creek Bench Canal	5M-4C	244.0
				TOTAL	451.0
11240	18914	10-202	Willow Creek Bench Canal	5W-1C	6.0
6626	18546	10-200	Dry Creek Bench Canal	5d-1C	35.0
6634	18394	20-219	Left Hand Canal	7-1C	20.0
8482	14936	6-228	Mosle	10-1C	239.33
3110E	14940	6-228	Enl. Mosle	10-2C	9.0
12979	14939	6-228	Snow	10-3C	10.0
				TOTAL	258.33

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
17865	24253	8-185	Phillips	11-1C	17.2
6624	19137	8-180	Jackson	14-1C	51.0
6616	18404	10-200	Washakie	14-2C	56.0
6616	18403	10-200	Washakie	14-3C$_1$	46.0
6616	18403	10-200	Washakie	14-3C$_2$	13.0
17203	19827	10-200	Washakie No. 2	14-4C	25.0
17203	19828	10-200	Washakie No. 2	14-5C$_1$	9.0
17203	19828	10-200	Washakie No. 2	14-5C$_2$	15.0
				TOTAL	215.0
15697	18541	12-140	Teapot Outlet	15-1C	101.0
15697	18541	13-112	Teapot Outlet	15-2C	555.93
9033	14881	13-112	Hays	15-3C	160.0
8217	16150	11-176	Gunter	15-4C	80.0
7492	11729	11-176	Pratt	15-5C	40.0
7556	13625	11-176	Tenderfoot Girl	15-6C	66.0
9713	11728	11-176	Red	15-7C	94.0
12277	15650	11-176	Blackwell	15-8C	111.0
2493E	15651	11-176	Enl. Blackwell	15-9C	21.0
12363	16838	11-176	Blackwell No. 2	15-10C	90.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
14823	16839	11-178	Signor	15-11C	13.0
9009	11727	11-178	Reo Seco	15-12C	29.0
7955	11726	11-178	Kennah	15-13C	38.0
2381E	13555	11-178	Enl. Kennah	15-14C	77.0
3272E	18911	11-178	Enl. Kennah	15-15C	77.0
17712	20737	11-178	French	15-16C	104.0
8291	13546	12-138	Edgar Beck	15-17C	160.0
3792E	19450	12-138	Enl. Becks Supply	15-18C	160.0
				TOTAL	1,976.93
11566	14876	9-155	Trosper	16-1C	140.0
8242	16154	9-155	Beeline	16-2C	110.0
4088E	18912	9-155	Enl. Beeline	16-3C	399.0
3703E	20285	9-155	Enl. Beeline	16-4C	105.0
7439	11730	9-155	Knifong No. 1	16-5C	64.0
15660	16840	9-155	Linck	16-6C	81.0
8243	16155	9-155	Stephens	16-7C	21.0
10110	14874	9-157	Brightop	16-8C	53.0
3034E	14875	9-157	Enl. Brightop	$16\text{-}9C_1$	2.3
3034E	14875	9-157	Enl. Brightop	$16\text{-}9C_2$	24.0
1629E	14038	9-157	Enl. Mills No. 2	16-10C	22.0
8344	17008	9-157	Sandell	$16\text{-}11C_1$	16.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
8344	17008	9-157	Sandell	$16\text{-}11C_2$	29.5
8344	14039	9-157	Sandell	16-12C	24.0
2667E	19132	9-157	Enl. Sandell No. 1	16-13C	10.0
7486	11733	9-157	Sandell	16-14C	62.0
1809E	11736	9-157	Enl. Sandell	16-15C	22.0
8065	16152	9-157	Rema	16-16C	21.0
8065	13561	9-157	Rema	16-17C	36.0
7424	13557	9-157	East Burk	16-18C	76.0
8066	16153	9-157	Crow	16-19C	51.0
7423	13556	9-157	West Burk	16-20C	24.0
8866	14873	9-157	Red Top	16-21C	27.0
7857	13559	9-157	Young and Ralston	$16\text{-}22C_1$	22.0
7857	13559	9-157	Young and Ralston	$16\text{-}22C_2$	37.0
7857	13560	9-157	Young and Ralston	16-23C	11.0
7857	14870	9-157	Young and Ralston	16-24C	82.0
2886E	14872	9-157	Enl. Young and Ralston	16-25C	31.0
1910E	14871	9-157	Enl. Young and Ralston	16-26C	13.0
12128	20284	9-157	H.P.	16-27C	38.0
7856	13558	9-157	Young	16-28C	48.0
8866	14873	10-198	Red Top	16-29C	81.0
12188	20284	10-198	H.P.	16-30C	45.0
8585	16156	10-198	Blue Grass	16-31C	73.0
11568	22485	10-198	Sandell and Bauman	$16\text{-}32C_1$	73.2
11568	22485	10-198	Sandell and Bauman	$16\text{-}32C_2$	48.8

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
15867	20287	10-198	Andy	16-33C	12.0
11375	13566	10-198	Saunders and Miller	16-34C	43.0
11375	13565	10-198	Saunders and Miller	16-35C	63.9
2697E	13568	10-198	Enl. Saunders and Miller	16-36C	9.0
11743	15653	10-198	John Miller	16-37C	27.0
9209	13562	10-198	A.L. Miller	16-38C	34.0
2698E	13569	10-198	Enl. Frank Saunders No. 1	16-39C	31.0
11373	13563	10-198	Frank Saunders No. 1	16-40C	6.4
2699E	13570	10-198	Enl. Frank Saunders No. 2	16-41C	8.3
11374	13564	10-198	Frank Saunders No. 2	16-42C	32.5
2639E	14878	10-200	Wickstrom Ex. of A.L. Miller	16-43C	24.3
2945E	19134	10-200	Enl. Borel No. 1	16-44C	59.0
3758E	15654	10-200	Enl. Borel	$16\text{-}45C_1$	16.0
3758E	15654	10-200	Enl. Borel	$16\text{-}45C_2$	26.0
9209	13562	10-200	A. L. Miller	16-46C	15.0
6621	17916	10-200	Rhodes No. 1	16-47C	48.0
6621	20879	10-200	Rhodes No. 1	16-48C	8.0
2681E	17191	10-200	Enl. Rhodes No. 1	16-49C	144.59
7525	17917	10-200	Rhodes No. 2	16-50C	8.0
2896E	14880	10-200	Enl. Borel No. 1	$16\text{-}51C_1$	50.0
2896E	14880	10-200	Enl. Borel No. 1	$15\text{-}51C_2$	22.0
2640E	14879	10-200	Enl. Borel No. 1	16-52C	27.2
7533	11735	10-200	Borel No. 1	16-53C	30.0
7534	11734	10-200	Borel No. 2	16-54C	74.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
11617	14877	10-200	Borel No. 3	$16\text{-}55C_1$	17.0
11617	14877	10-200	Borel No. 3	$16\text{-}55C_2$	15.0
4141E	19135	10-200	Enl. Borel No. 3	16-56C	45.1
4140E	19133	10-200	Enl. A. L. Miller	16-57C	8.2
				TOTAL	2,927.29
11659	14951	11-170	Kirkland	17-1C	11.1
7990	11672	18-349	Wittaker	18-1C	39.0
7522	16141	19-242	Gonzales No. 1	18-2C	40.0
7770	11681	19-242	Ingalls	18-3C	20.0
7588	11678	20-235	Two Partners	18-14C	30.0
4414E	19121	20-235	Enl. Two Partners	18-15C	158.0
11744	15115	20-235	Mary	18-16C	30.0
13430	19120	20-235	Stagner	18-17C	17.8
15294	18523	20-235	Bean No. 1	18-18C	28.0
7490	11670	21-180	Deer Trail	18-19C	30.0
4400E	20554	21-180	Enl. Deer Trail	18-20C	27.0
7491	11669	21-180	Bear Paw	18-21C	20.0
7488	11671	21-180	Berch	18-22C	15.0
15540	18526	21-180	Lincoln	$18\text{-}23C_1$	5.0
15540	18526	21-180	Lincoln	$18\text{-}23C_2$	15.0
15541	18527	21-180	Lincoln No. 2	18-24C	17.0
7653	11673	22-172	Two Mile Springs	18-25C	13.0
				TOTAL	504.8

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
8539	13547	8-185	Black Rock	19-1C	324.7
8539	13549	8-185	Black Rock	19-2C	42.0
8539	13550	8-185	Black Rock	19-3C	115.0
2168E	13554	8-185	Enl. Black Rock	19-4C	35.0
16426	20177	10-200	Nowlin	19-5C	28.0
4714E	20539	10-200	Enl. Nowlin	19-6C	71.0
4366E	20178	10-200	Enl. Nowlin	19-7C$_1$	8.7
4366E	20178	10-200	Enl. Nowlin	19-7C$_2$	23.3
6619	18905	11-170	Boyd	19-8C	127.5
14691	14853	11-170	Hagin	19-9C	85.0
3773E	18908	11-170	Enl. Hagin	19-10C	59.0
2292E	16835	12-140	Enl. Stagner	19-11C	30.0
2292E	13553	12-140	Enl. Stagner	19-12C	70.0
14910	16834	13-112	Brant	19-13C	76.0
13484	20283	13-112	Driscoll	19-14C	156.06
Terr.	11695	15-29	Kinnear	19-15C	79.0
Terr.	11697	16-106	Kinnear	19-16C	8.0
				TOTAL	1,338.26
16580	19437	13-122	French	20-1C	482.4
8215	11682	13-122	Pearl	20-2C	45.0
2139E	18389	13-122	Enl. Pearl	20-3C	127.5
7094	17190	14-49	Wiederien	20-4C	6.0
7094	11683	14-49	Wiederien	20-5C	69.5
Terr.	13595	14-49	Muddy Springs No. 1	20-6C$_1$	50.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
Terr.	13595	14-49	Muddy Springs No. 1	20-6C$_2$	26.0
Terr.	11688	14-49	Muddy Springs No. 2	20-7C	17.0
7373	11689	14-49	Muddy Springs No. 3	20-8C	7.0
2903E	17186	14-49	Enl. Hoise No. 2	20-9C$_1$	41.0
2903E	17186	14-49	Enl. Hoise No. 2	20-9C$_2$	126.0
15366	17189	14-49	Bargee No. 2	20-10C	7.0
7371	11687	14-49	Holland Creek	20-11C	38.0
7372	11690	14-49	Deep Spring	20-12C	4.0
7905	11684	14-49	Rankin	20-13C	104.0
8139	11685	14-49	George	20-14C	63.0
8610	14933	15-39	Stoffer	20-15C	26.0
12662	18522	15-39	Robert M. Metzler	20-16C$_1$	14.0
12662	18522	15-39	Robert M. Metzler	20-16C$_2$	47.1
16287	18387	15-39	Preston No. 1	20-17C	84.0
16288	19123	15-39	Preston No. 2	20-18C$_1$	9.0
16288	19123	15-39	Preston No. 2	20-18C$_2$	26.0
7449	11674	15-39	Shotgun	20-19C	85.0
10208	21703	15-41	Limfjorden	20-20C	8.0
3251E	16805	15-41	Enl. Limfjorden	20-21C	16.0
13064	16802	15-41	Granger No. 2	20-22C	40.0
18721	22597	16-92	Store Aaen	20-23C	29.6
17239	19981	16-92	Kabbel	20-24C	16.0
5058E	22598	16-92	Enl. Kabbel	20-25C	8.2
6959	13539	16-92	Edmo LeClair	20-26C	39.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
16665	19434	16-92	Jim No. 1	20-27C	22.0
16666	19565	16-92	Jim No. 2	20-28C	5.5
8914	13542	16-94	Calling	20-29C	76.0
3805E	16803	16-94	Enl. Calling	20-30C	4.0
3806E	16804	16-94	Enl. Calling	$20\text{-}31C_1$	1.0
3806E	16804	16-94	Enl. Calling	$20\text{-}31C_2$	1.0
3806E	16804	16-94	Enl. Calling	$20\text{-}31C_3$	1.0
3806E	16804	16-94	Enl. Calling	$20\text{-}31C_4$	2.0
12447	18388	16-94	West Fork Sheep Creek No. 2	20-32C	168.0
8540	11679	16-94	Nielson	20-33C	159.0
7675	11675	16-96	J.W.O.	20-34C	164.5
2821E	15379	16-96	Enl. J.W.O.	20-35C	14.0
9722	16147	16-96	R. W. Philburn	20-36C	73.2
9722	16147	17-81	R. W. Philburn	20-37C	85.4
9723	16465	17-81	W. W. Philburn	20-38C	49.3
8062	13537	17-81	Swanson	20-39C	123.0
2311E	14935	17-81	Enl. Swanson	20-40C	29.0
3276E	21701	17-81	Enl. Swanson	20-41C	32.0
4534E	21702	17-81	Enl. Swanson	20-42C	40.0
14149	14934	17-81	Reno	20-43C	14.0
15267	16806	17-81	Carl	20-44C	2.0
7669	13540	17-83	Owens	20-45C	106.0
1984E	19435	17-83	Enl. Owens	20-46C	38.0
16912	19286	17-85	O'Shea	20-47C	30.0
				TOTAL	2,901.2

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
12179	16411	14-53	Muddy Prairie Basin	21-1C	156.16
6588	19830	12-148	North Fork No. 1	22-1C	38.5
6588	20736	12-148	North Fork No. 1	22-2C	247.8
6588	21000	12-148	North Fork No. 1	22-3C	125.6
6590	19144	13-106	North Fork No. 3	22-4C	40.9
6591	19145	13-106	North Fork No. 4	22-5C	32.5
				TOTAL	485.3
6583	18583	13-104	South Fork No. 1	23-1C	87.6
6583	18582	13-104	South Fork No. 1	23-2C	19.6
				TOTAL	107.2
13426	18567	12-144	North Fork Sage Creek No. 1	25-1C	102.4
16545	20738	12-146	Church No. 1	25-2C	28.0
16546	20739	12-146	Church No. 2	25-3C	45.0
16547	20740	12-146	Church No. 3	25-4C	31.0
				TOTAL	206.4
8913	14847	22-162	Fuller Brothers	30-1C	100.0
16943	19153	15-19	McDowell	31-1C	13.0
7432	10929	16-116	Sioux	31-2C	120.0
3158E	16171	16-116	Enl. Sioux	31-3C	107.0
4554E	20049	16-116	Enl. Sioux	31-4C	80.0
				TOTAL	320.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
7528	15767	17-63	O'Neal	32-1C	40.0
8721	11407	H5-266	Morrison and McConaughy	33-1C	111.3
8721	12985	H5-266	Morrison and McConaughy	33-2C	168.08
2187E	15388	H5-266	Enl. Morrison & McConaughy	33-3C_1	318.5
2187E	15388	H5-266	Enl. Morrison & McConaughy	33-3C_2	18.0
8623	15395	H5-266	Shoop	33-4C_1	19.0
8623	15395	H5-266	Shoop	33-4C_2	12.0
8623	15395	H5-266	Shoop	33-4C_3	7.0
8623	14028	H5-266	Shoop	33-5C_1	25.0
8623	14028	H5-266	Shoop	33-5C_2	10.0
8623	14028	H5-266	Shoop	33-5C_3	10.0
7426	10907	H5-266	Shoop Spring	33-6C	17.0
10126	15394	H5-266	Large	33-7C	267.0
11707	14032	H4-17	Typer No. 4	33-8C	64.0
6621	14024	H4-17	Riggs	33-9C	27.0
9058	10906	H5-270	Typer No. 2	33-10C	32.0
				TOTAL	1,105.88
Terr.	3526	H5-264	Sliney and Mikkelson	34-1C	122.63
Terr.	3526	H6-225	Sliney and Mikkelson	34-2C	32.0
Terr.	3527	H5-264	Sliney and Mikkelson	34-3C	222.63
Terr.	3534	H6-225	Padlock	34-4C	224.35
2306	6271	H5-264	DeWitt	34-5C	17.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
4038	8350	H5-264	Sliney No. 1	34-6C	160.0
4038	8351	H5-264	Sliney No. 1	34-7C	160.0
2125E	15024	H5-264	Rothwell Enlargement of Enl. Sliney No. 1	34-8C_1	85.0
2125E	15024	H5-264	Rothwell Enlargement of Enl. Sliney No. 1	34-8C_2	233.0
Terr.	3533	H5-264	Padlock	34-9C	252.0
Terr.	3534	H5-264	Padlock	34-10C	41.0
Terr.	3534	H6-223	Padlock	34-11C	285.44
2187E	11409	H5-264	Enl. Morrison & McConaughy	34-12C	20.43
2187E	15388	H5-264	Enl. Morrison & McConaughy	34-13C	312.28
2187E	15388	H5-266	Enl. Morrison & McConaughy	34-14C	54.7
8721	11407	H5-266	Morrison and McConaughy	34-15C_1	21.0
8721	11407	H5-266	Morrison and McConaughy	34-15C_2	21.0
8721	11408	H5-266	Morrison and McConaughy	34-16C	143.03
				TOTAL	2,407.49
10052	15042	H4-284	Bagley	35-1C	61.0
8869	12996	H4-284	McElwee	35-2C	74.0
10019	19118	H4-284	Robinson	35-3C_1	53.0
10019	19118	H4-284	Robinson	35-3C_2	12.0
6956	19117	H4-284	Duncans Mud Creek	35-4C	50.0
6956	19116	H4-284	Duncans Mud Creek	35-5C_1	22.0
6956	19116	H4-284	Duncans Mud Creek	35-5C_2	15.0
8486	18383	H4-284	A. L. Lydick	35-6C	67.0

ADJUDICATED ACREAGE CLAIM ON TRUST LANDS (Continued)

Permit Number	Proof Number	Photo Number	Ditch Name	Tract Number	Claimed Trust Acres
13121	17398	H4-286	Ford No. 1	35-7C	138.0
3856E	17010	H4-286	Enl. Ford No. 1	35-8C	56.9
13122	17399	H4-286	Ford No. 2	35-9C	2.0
3857E	17011	H4-286	Enl. Ford No. 2	35-10C	7.6
14976	17009	H4-286	Steward	35-11C	10.2
8533	18384	H4-286	Wilson	35-12C	70.0
8063	10911	H4-288	Sherard	35-13C	17.5
7366	15393	H3-338	Foster	35-14C	98.0
				TOTAL	754.2
12877	15755	H4-15	Phlox Mt.	36-1C	70.5
14395	15754	H4-15	Red Creek	36-2C	4.9
9565	13536	H4-15	Rabenstein	36-3C	143.0
8131	11410	H4-15	North Side	36-4C	127.0
1810E	11411	H4-15	Enl. North Side	36-5C	15.0
13431	19564	H4-15	Finley	36-6C	10.9
				TOTAL	371.3
13409	20247	13-102	Driscoll No. 1	37-1C	28.2
13410	20185	13-102	Driscoll No. 2	37-2C	8.8
				TOTAL	37.0

II. UNADJUDICATED IN-USE

2. A study was done on the Wind River Indian Reservation by H.K.M. Associates under the direction and control of Ron Billstein, a civil engineer qualified in water resource planning, to locate and quantify lands held in trust by the United States for the Shoshone and Arapahoe Indian Tribes that were receiving water in 1980. United States Exhibits WRIR C-138, WRIR C-139, Tr. 1894-2974.

3. The study to determine lands in current use was a part of the "historic lands" segment of the United States' case in chief. Historic lands are trust lands which are currently or have historically been irrigated or which can be served from historic irrigation facilities. The lands in current use are defined as those lands which are presently receiving irrigation water but which do not lie within adjudicated water right service areas. United States Exhibit WRIR C-138, p. 1.

4. Current aerial photography (1979-80) was used to document by visual means the total area of investigation plus serve as a base to map present and past irrigation on the reservation. Water rights of record and unrecorded use areas documented through BIA and SCS files were utilized to locate historically irrigated areas on the photographs. United States Exhibit WRIR-C 138, pp. 2-5; WRIR C-56A through C-136A. Tr. 1901-04.

5. After locating potentially irrigated areas on the aerial photographs, each area was stereoscopically analyzed to locate historic irrigation facilities as well as associated irrigated land. All 1979-80 aerial photos, with the exception of those located within the Federal Irrigation Projects and private projects were stereoscopically analyzed. United States Exhibit WRIR C-138, pp. 3-6, Tr. 1907-17. The Wind River Federal Irrigation Project area was excluded from the photo-interpretation effort as irrigation facilities are documented on BIA project facility maps and initial land use determinations were previously made in an earlier field study completed by H.K.M. in 1979. The other major projects (Le Clair, Midvale, Riverton Valley) are almost entirely non-Indian and current use was evaluated by field inspection of the limited number of tracts associated with trust land. United States Exhibit WRIR C-130, p. 5, Tr. 1906-17.

6. The stereoscopic analysis was supplemented with a review of aerial photographs which covered the following time frames: 1936, 1939, 1948, 1954, and 1969. These photos assisted in documenting historic use as well as aiding in identifying irrigation service facilities. United States Exhibit WRIR C-138, pp. 5-6.

7. After a historic lands study base was established it was screened for trust ownership by the use of Bureau of Indian

Affairs plats which defined the status of trust acreage on the Reservation as of April, 1980. United States Exhibit WRIR C-138, p. 6, Tr. 1918-22.

8. All land identified on the aerial photographs as being historically in use was assigned a land type to designate the degree or type of current water use. These land types are defined as follows:

Type I: Intensively Irrigated Cropland

Usually have an adequate or nearly adequate water supply. Generally devoted to raising row crops or crops in rotation. Irrigation systems are generally well developed and maintained.

Type II: Irrigated Cropland With An Adequate Water Supply

Generally devoted to raising hay crops or hay, small grains, and pasture. Irrigation systems may not be as well developed and maintained as Type I.

Type III: Meadow Irrigation

Usually have an adequate early season water supply and may have an adequate year around supply. Usually located at higher elevations and are devoted to raising native or improved grass-legume hay. Irrigation systems are generally poorly developed and continuous irrigation is common.

Type IV: Occasionally Irrigated - Partial Service

Lands irrigated sporadically or irregularly by water spreading systems or by conventional systems. Water supply may be limited. Native hay and pasture are the usual land uses.

Type V: Subirrigated or "Seeped" Lands

Are not intentionally irrigated but receive sufficient water from adjacent irrigated lands, canals and/or from streams to provide beneficial use.

Type VI: Lands are irrigated sporadically or irregularly by conventional systems. They are poor quality, and require a higher level of irrigation management. Water supply is adequate. Native hay and pasture are the usual land uses.

Type VII: Idle Lands

Type VIII: Undeveloped arable lands within the Wind River Federal Irrigation Project. Wyoming Exhibit HB-8, Tr. 2040-41.

9. Only lands within Types I - VI were counted as currently receiving water. Types VII and VIII were subjected to arability and irrigability tests. See Findings 48 through 90. Tr. 2042.

10. Current and historic use was also verified by reviewing the assessment records within the federal irrigation projects and private projects. If landowners were paying for water delivery to the land it was considered a strong indication of current water use on that land. Tr. 1936, 2150-53.

11. Color infra-red photography and the 1968-1970 Soil Conservation Service irrigated lands inventory were also reviewed for indications of historic water application. Tr. 1937, 2143, 2150-53, 2860-65, 3151.

12. All trust land that had been identified as being historically irrigated by the previously described methods underwent a tract by tract field investigation to verify whether it was currently receiving water. The field investigation was conducted by surface vehicle or helicopter. Landowners, Bureau of Indian Affairs water administrators and ditch riders were interviewed to obtain supplemental information on each irrigation operation. A subsequent field review was also made by Mr. Billstein in February 1981 to check, review and verify the findings. Tr. 1923-38, 1957, 2105-09, 2151, 2740-41, 2838-39, 2842-43, 2962, United States Exhibit WRIR C-138, pp. 7-8.

13. Findings were mapped on aerial photographs and the acreage was quantified by planimeter methods. Only the acres actually receiving water were counted. United States Exhibit WRIR C-138, pp. 7-8, Tr. 2587, 2643.

14. As a result of the study it was determined that there are 34,427 acres of trust land that are currently receiving water on the Wind River Indian Reservation. United States Exhibits WRIR C-137A; WRIR C-56 through C-134; WRIR C-56A through C-134A.

UNADJUDICATED IN USE

ACRES IN USE BY LOCATION

Description	Acres In Use
PROJECT LANDS	
1. Wind River Irrigation Project	
Little Wind Unit [1]	
Ray Unit	7,782
Coolidge Unit	6,357
Subagency Unit	2,962
Upper Wind Unit [2]	
Wind River "A" Canal	1,019
Dinwoody Bench Area	4,611
Johnstown Unit [3]	465
Lefthand Unit [3]	1,541
	24,737
Description	**Acres In Use**
2. Midvale Irrigation District [3]	
Trust Lands	569
	569
3. LeClair Irrigation District [3]	
Trust Lands	1,271
	1,271

1/ Water sources include North Fork, Little Wind River, South Fork Little Wind River, Little Wind River, Trout Creek and Mill Creek.

2/ Water sources include Wind River, Dinwoody Creek, Dry Creek, Meadow Creek and Willow Creek.

3/ Water source is Wind River.

NON-PROJECT LANDS	Acres In Use
1. Wind River Basin	
East Fork Wind River	10
Dinwoody Creek	154
Dry Creek	183
Bull Lake Creek	26
Meadow Creek	179
Dry (Pasup) Creek	56
Crow Creek	36
Willow Creek	7
Wind River Main Stem	489
	1,138
2. Little Wind River Basin	
North Fork Little Wind	1,776
South Fork Little Wind	781
Main Stem Little Wind	386
Sage Creek	776
Crooked Creek	69
Trout Creek	228
Spring Creek	178
Bighorn Draw	139
	4,333
3. Bighorn River Basin	
Main Stem Bighorn River	2
Cottonwood Creek	320
Muddy Creek	1,194
Fivemile Creek	362
	1,878
4. Popo Agie River Basin	
North Fork Popo Agie	112
Main Steam Popo Agie	74
	186
5. Owl Creek Basin	
Main Stem Owl Creek	46
South Fork Owl Creek and Tributaries	84
Mud Creek	185
	315
GRAND TOTAL:	34,427

III. LAND CLASSIFICATION

A. Future Lands

15. The geological setting of the Wind River Reservation has a dominating influence on the suitability of the soils for sustained irrigation. Potential arable lands on the reservation have developed primarily on gravel terraces and recent alluvium. United States Exhibit WRIR C-43, p. 1.

16. There is a wide range of topography within the Wind River Reservation, including nearly level and flat terraces, river bottoms, steep mountain slopes, dissected lands and rolling hills. The Wind River and its tributaries are bordered by a series of terraces rising steplike above the bottom lands. Areas suitable for irrigation are predominately comprised of terrace remnants, colluvial slopes and alluvial valleys. Exhibit WRIR C-43, p. 2.

17. A land classification and drainage investigation was conducted on the Wind River Indian Reservation for the United States on undeveloped future lands by H.K.M. Associates, under the direction and control of A. T. Kersich, an experienced Agricultural Engineer. Tr. 1103-19, United States Exhibit WRIR C-34.

18. Mr. Kersich is president of H.K.M. and principal-in-charge of its water resources division. Tr. 1097, 1127. Mr. Kersich brought his considerable agricultural engineering experience to the land classification program and helped formulate the study and verify that all of the necessary data was passed

on to Dr. Mesghinna and Stetson Engineers. Tr. 1116-19. Mr. Kersich has previously served as project leader for similar studies on other Indian reservations and appeared as an expert witness on behalf of the United States in the recently decided case of Arizona v. California, United States Supreme Court, No. 8 Original. Mr. Kersich is a registered professional engineer in the States of Wyoming, Montana, North Dakota, Utah and New Mexico. United States Exhibit WRIR C-34; Tr. 1099-112.

19. A screening process was used to narrow the reservation lands down from 2 1/2 million acres to approximately 281,000 acres which were classified. United States Exhibit WRIR C-43, pp. 6-8-6-8, 22; United States Exhibit WRIR C-35, Tr. 1120-23.

20. The lands were classified using site specific land classification specifications that were developed by a group of qualified professionals of varying disciplines consisting of agricultural engineers, land classifiers, soil scientists and a drainage engineer. Tr. 1125-30, 3735-39; United States Exhibit WRIR C-43, pp. 6-8.

21. The areas classified on the Wind River Indian Reservation were broken down into six study areas: North Crowheart, South Crowheart, Arapahoe, Big Horn Flats, Riverton East and Owl Creek. United States Exhibit WRIR C-43, p. 8; United States Exhibit WRIR C-35; Tr. 1123-24.

22. The site specific land classification specifications were based on available published information (Soil Conservation Service [SCS] and Bureau of Indian Affairs [BIA] soil surveys, and United States Bureau of Reclamation [USBR] land classifications), together with professional judgment and local expertise. A dual classification for both gravity and sprinkler irrigation was implemented. This allowed the best method of irrigation to be applied for site specific conditions. United States Exhibit WRIR C-43, p. 8, Table 2, pp. 10-12.

23. The land classification standards used by Mr. Kersich and H.K.M. break the land classified into Classes 1, 2, 3, 4, 5 and 6. Class 1 are defined as lands of high quality for irrigation and which yield high returns with minimum production and management costs. Class 2 lands are good quality lands with only minor deficiencies. Class 3 lands consist of fair quality lands having more serious deficiencies than Class 2 lands. Class 4 lands are of marginal quality for irrigation and are used mainly for shallow rooted crops or pasture. Class 5 lands are those lands which have been placed into a deferred status pending further investigation. There were no lands included in a deferred status. Class 6 lands do not meet the minimum requirements for an arability determination under the land classification standards used in this study. United States Exhibit WRIR C-43, pp. 8-9.

24. The land classification standards contain inherent economic considerations and many agricultural engineering considerations. Tr. 1115-16, 1127-29, 1171, 1315, 1430-33 and 3738.

25. A modified semi-detailed land classification of undeveloped lands within the study areas was conducted by land classifiers from H.K.M. with many years of experience. Tr. 1127, 1154, United States Exhibit WRIR C-43, pp. 8, 14-15.

26. Soils were considered from the standpoint of: texture, structure, depth to sand, gravel, bedrock or zones restricting either water movement and/or root development, and alkalinity or salinity. Smoothing was considered in the sprinkler classification. Topography was evaluated on the basis of general slope, size and shape of field. Leveling was considered only in the gravity class determination. Soil drainage was appraised on the basis of conditions anticipated with irrigation. Shallow depth of soil to shale, sandstone or gravel in the profile in portions of the reservation limited the depth of a number of hand augered holes. On the gravel terraces, where gravelly horizons were encountered, backhoe pits were dug to ascertain the characteristics of the gravelly horizons. United States Exhibit WRIR C-43, p. 15, Tr. 1454-55 and 1457-59.

27. In general, one 10-foot boring for the predominant land form in each section was made. As many 5-foot borings were dug and logged as the classifier judged necessary for accurate classification. One hundred and ninety-seven borings between 5

and 10 feet and 357 borings of 5 feet or less were augered and logged, and 9 backhoe pits were dug in representative soils. One hundred seventeen deep holes were drilled and logged as part of the drainage analysis. United States Exhibit WRIR C-43, pp. 15-16.

28. Soil chemical tests were run on selected samples. Ninety-five 10-foot borings and 70 5-foot borings were sampled for chemical analysis. A total of 927 samples were analyzed. Samples from 165 holes were analyzed for soil chemistry by the H.K.M. soils laboratory using accepted laboratory procedures. United States Exhibit WRIR C-43, pp. 20-21.

29. Eleven infiltration and 22 hydraulic conductivity tests were run in representative textures in the classified area to obtain information on the infiltration and permeability characteristics of typical soil textures within the reservation. United States Exhibit WRIR C-43, p. 16.

30. Information from the United States Bureau of Reclamation 1961 Study was utilized by H.K.M. United States Exhibit WRIR C-43, p. 16, Tr. 3744-50.

31. A drainage investigation was conducted by Robert Toedter, a well qualified drainage engineer, to determine whether suitable characteristics are present to provide sufficient natural drainage, or whether drains are needed to prevent waterlogging from developing. The soil characteristics identified were depth to barrier, hydraulic conductivity and soil texture. United States

Exhibit WRIR C-43, p. 16, United States Exhibit WRIR C-30, United States Exhibits WRIR C-231 through WRIR C-236, WRIR C-231A, WRIR C-233A through WRIR C-236A, WRIR C-241A, WRIR C-243, Tr. 3702-31, 1167-68, 3744-46, 3751-3829.

32. Mr. Toedter has considerable experience in drainage work associated with land classification. Mr. Toedter has participated in various stages of drainage work from field drilling to actual design and physical layout of drainage systems. United States Exhibit WRIR C-30, Tr. 3702-07, 3730.

33. All conclusions and results from the drainage investigations regarding depth to barrier and hydraulic conductivity were conveyed to Stetson Engineers for use in their irrigation system and drainage system designs. Tr. 3826-27, 3830, United States Exhibits WRIR C-231 through WRIR C-236, WRIR C-241A, WRIR C-241B.

34. Depth to barrier and hydraulic conductivity are important considerations for the agricultural engineer in irrigation and drainage system design. Tr. 3826-27, 3830, and 3954.

35. The lands are either alluvial or colluvial with shale or sandstone forming the natural barrier. The depth of arable colluvial soils ranges from 6 to 20 feet. The depth to barrier in the upland terraces and alluvial flood plains is generally greater than 20 feet. Topsoils are generally medium textured ranging from sandy loams to sandy clay loams and are underlain by subsoils ranging in texture from sandy loam to clay loam. Typically, the subsoils are either sandy clay loams or sandy loams. Terraces

throughout the proposed units exhibit gravelly topsoils underlain with graded gravelly subsoils having high hydraulic conductivities. United States Exhibit WRIR C-43, p. 17.

36. The results of the drainage investigation, laboratory analysis and land classification field program were examined and evaluated and final land classification determinations were made. All pertinent information was then inked on aerial photographs to make a permanent record of the survey. United States Exhibits WRIR C-148-1 through C-148-30 and WRIR C-43, p. 21.

37. Copies of all aerial photographs containing land classification determinations were conveyed to the agricultural engineering consultant, Stetson Engineers. United States Exhibit WRIR C-43, p. 21, United States Exhibit WRIR C-148-1 through WRIR C-148-30, Tr. 1175.

38. All soil logs containing relevant soil information and all laboratory and field tests were sent to Stetson Engineers. Tr. 1166, 1173, 1175, United States Exhibits WRIR C-147A through WRIR C-147C.

39. The lands upon which Dr. Mesghinna designed the Riverton East proposed irrigation system were classified as arable by H.K.M. and are reflected within the arable acreage totals in United States Exhibit WRIR C-43, pp. 26-27, as noted in the tabulation sheets. Wyoming Exhibit SK-53. Even though these lands are not reflected on United States Exhibit WRIR C-50 and WRIR

C-51, the classification is reflected on the actual aerial photos used by the field team. United States Exhibit WRIR C-148-1 through WRIR C-148-30.

40. As a result of the land classification and drainage investigation conducted on the Wind River Indian Reservation, there are 84,469 acres of undeveloped arable land as defined by the land classification criteria within the study areas. Tr. 1213, United States Exhibit WRIR C-43, pp. 22, 27, WRIR C-41, WRIR C-42.

41. All arable lands are capable of being irrigated by sprinkler irrigation. United States Exhibit WRIR C-43, p. 27.

42. In the North Crowheart study area there are 6,704 acres of Class 1 land, 22,293 acres of Class 2 land, 18,873 acres of Class 3 land, 6 acres of Class 4 land, for a total of 47,876 acres. Of the 47,876 arable acres, there are 6,704 Class 1 gravity, 21,742 acres of Class 2 gravity, 18,197 acres of Class 3 gravity and 6 acres of Class 4 gravity, for a total of 46,649 acres of arable land by gravity classification. For the additional areas that can be irrigated by sprinkler irrigation only, there are 0 acres of Class 1 land, 603 acres of Class 2 land, 624 acres of Class 3 land and 0 acres of Class 4 land, for a total of 1,227 acres of additional sprinkler lands. United States Exhibit WRIR C-43, p. 27 through WRIR C-45.

43. In the South Crowheart study area there are 167 acres of Class 1 land, 4,493 acres of Class 2 land, 3,100 acres of Class 3 land, 224 acres of Class 4 land, for a total of 7,984

acres of arable land. Of the 7,984 arable acres in the South Crowheart study area, there are 139 acres of Class 1 by gravity classification, 3,476 acres of Class 2, 2,343 of Class 3 and 69 acres of Class 4 land by gravity classification, for a total of 6,027 acres. For lands that are arable by sprinkler irrigation only, there are 28 acres of Class 1 land, 1,017 acres of Class 2, 757 acres of Class 3 and 155 acres of Class 4, for a total of 1,957 acres of additional sprinkler classification land. United States Exhibits WRIR C-43, p. 27, WRIR C-46, WRIR C-47.

44. In the Big Horn Flats study area there are 1,206 acres of Class 1 land, 6,279 acres of Class 2 land, 11,689 acres of Class 3 land, 470 acres of Class 4 land, for a total of 19,644 acres of arable land. Of the 19,644 acres of arable land, there are 865 acres of Class 1 land by gravity classification, 6,088 acres of Class 2, 8,131 acres of Class 3, and 112 acres of Class 4, for a total of 15,196 acres by gravity classification. For classification of land by sprinkler irrigation only, there are 341 acres of Class 1 land, 191 acres of Class 2, 3,558 acres of Class 3, and 358 acres of Class 4, for a total of 4,448 acres classified as arable for sprinkler irrigation only. United States Exhibits WRIR C-43, p. 27, WRIR C-48, WRIR C-49.

45. In the Riverton East study area there are 113 acres of Class 1 land, 1,386 acres of Class 2 land, 3,192 acres of Class 3 land, 0 acres of Class 4 land, for a total of 4,691 acres of arable land. Out of 4,691 acres of arable land by gravity

classification only, there are 113 acres of Class 1 land, 860 acres of Class 2 land, 2,251 acres of Class 3 land, 0 acres of Class 4 land, for a total of 3,224 acres of arable land by gravity classification only. For arable land to be irrigated by sprinkler only, there are 0 acres of Class 1 land, 526 acres of Class 2 land, 941 acres of Class 3 land, and 0 acres of Class 4 land, for a total of 1,467 acres of arable land by sprinkler irrigation only. United States Exhibits WRIR C-43, p. 27, WRIR C-50, WRIR C-51.

46. In the Owl Creek study area there are 183 acres of Class 1 land, 75 acres of Class 2 land, 0 acres of Class 3 land and 0 acres of Class 4 land, for a total of 258 acres of arable land. Out of the 258 acres of arable land, there is no arable land by gravity classification. All arable land in the Owl Creek study area is arable for sprinkler irrigation only. United States Exhibits WRIR C-43, p. 27, WRIR C-52.

47. In the Arapahoe study unit there are 446 acres of Class 1 land, 2,085 acres of Class 2 land, 1,485 acres of Class 3 land, and 0 acres of Class 4 land, for a total of 4,016 acres of arable land. Out of the 4,016 acres of arable land by gravity classification, there are 143 acres of Class 1 land, 1,029 acres of Class 2 land, 1,146 acres of Class 3 land and 0 acres of Class 4 land, for a total of 2,318 acres of arable land by gravity classification only. For lands that are arable by sprinkler irrigation only, there are 303 acres of Class 1 land, 1,056 acres of Class 2 land, 339 acres of Class 3 land and 0 acres of Class 4 land for a total of 1,698 acres of arable lands by sprinkler irrigation only. United States Exhibits WRIR C-43, p. 27, WRIR C-53, WRIR C-54.

B. Historic Lands

48. A land classification and drainage investigation was conducted on the Wind River Indian Reservation for historically irrigated lands by H.K.M. Associates, under the direction of Ross Waples, an experienced soil scientist and land classifier. Tr. 3285-91, 3293, 3315, United States Exhibit WRIR C-157.

49. Mr. Waples has considerable experience in land classification of irrigated agriculture and other soil-related projects. Mr. Waples has personally taken part in land classifications totalling approximately 88,000 acres. Mr. Waples classified approximately 40,000 acres on the Wind River Indian Reservation. United States Exhibit WRIR C-157, Tr. 3288-90, 3297, 3315,

50. Historic lands are defined as trust lands which are currently or have historically been irrigated or which can be served from historic irrigation facilities. United States Exhibits WRIR C-138, p. 1, WRIR C-226, p. 1, Tr. 3372.

51. Although the largest contiguous blocks of arable acreage on the reservation are found in the undeveloped lands study areas, it was reasonable to expect that other lands that are not presently irrigated could be proven to be arable. Of those lands, the acreage that could be served from historic irrigation facilities was deemed to have the highest probability of being proved irrigable. Aerial photos from other time frames (1936, 1939, 1948, 1954, and 1969) verified that many of these lands

were, in fact, irrigated in the past. United States Exhibit WRIR C-138, p. 2.

52. All idle land within the historic study area as shown on United States Exhibit WRIR C-55 were classified and determined to be arable or non-arable Type VII or arable Type VIII land. Tr. 3294.

53. Type VII lands are defined as trust lands which have a history of irrigation or could be served from historic facilities. United States Exhibit WRIR C-138, pp. 1 and 7, Tr. 5254, Wyoming Exhibit HB-8.

54. Type VIII lands are undeveloped arable lands within the Wind River Federal Irrigation Project. Tr. 5582, Wyoming Exhibit HB-8, United States Exhibit WRIR C-138, p. 7.

55. In determining arability of historic lands two separate study areas were developed: major project lands and non-project lands. Within these two areas land classification studies were performed to establish arability of lands not presently irrigated. United States Exhibit WRIR C-226, p. 1, WRIR C-55, Tr. 3294.

56. A distinction was drawn between the land classification program performed on lands within large irrigation projects and classification performed on small privately irrigated fields. The primary difference in field programs involved tailoring the land classification criteria to suit the problems encountered in either a project or non-project setting. United States Exhibit WRIR C-226, p. 1, Tr. 3336.

57. Previous soil and land investigations were evaluated prior to the actual land classification. United States Exhibit WRIR C-226, p. 2.

58. The field program for historic project lands did not differ substantially from the future lands program as set forth in United States Exhibits WRIR C-43, WRIR C-226, p. 2, Tr. 3334.

59. Lands were evaluated topographically and typically a hole was augered in each large tract of potentially arable land to provide relevant soil data. United States Exhibit WRIR C-226, p. 2.

60. Land classification standards utilized for the project arable land study were identical to those used for H.K.M.'s classification of the North Crowheart, South Crowheart, Big Horn Flats, Owl Creek and Arapahoe study areas. United States Exhibit WRIR C-226, p. 2, Table 1, pp. 5, 6, and 7.

61. The same land class definitions were used as in the future land classification program. United States Exhibits WRIR C-43, pp. 8-9, WRIR C-226, p. 3. (See Findings 23.

62. Land classification field work on the historic project lands was carried out at a modified semi-detailed level of investigation. H.K.M.'s modified semi-detailed study is similar to the USBR semi-detailed study but calls for more deep holes, allowing a more accurate subsurface characterization. United States Exhibit WRIR C-226, pp. 9 and 10.

63. Soils were considered from the standpoint of: texture, structure, depth to sand, gravel, bedrock or zones restricting either water movement and/or root development; and alkalinity or salinity. Topography was evaluated on the basis of general slope, size and shape of field. Leveling was considered only in the gravity class determination. United States Exhibit WRIR C-226, pp. 10, 15, 16 and 17.

64. Soil drainage was appraised on the basis of conditions anticipated with project irrigation. These include: evidence of a water table developing in the root zone, depth to bedrock or a zone restricting water movement; and position of field in relation to surrounding potentially arable lands. United States Exhibit WRIR C-226, pp. 10, 17.

65. Each parcel of land was examined, evaluated and the appropriate land class boundary and preliminary symbol placed on aerial photographs. Location of all soil profiles were further documented on the aerial photographs. The land classification was finalized after all available data (chemical, land classification and drainage) was compiled. United States Exhibit WRIR C-226, p. 10, Tr. 3333-34, 3343.

66. Shallow depth of soil to gravel or cobble in the profile in portions of the reservation limited the depth of a number of hand augered holes, but often other evidence was available to ascertain depth to barrier. Cut banks and general observation of the morphology of the land helped make the land classification accurate. United States Exhibit WRIR C-226, p. 10, Tr. 3329-30, 3554-57.

67. In the Federal Irrigation Projects or major private projects (LeClair, Riverton Valley and Midvale Irrigation Districts; Johnstown, Upper Wind, Ray, Coolidge and Sub-Agency Units) idle and undeveloped lands typically had one hole per large field augered which was logged and sampled. United States Exhibit WRIR C-226, p. 10, Tr. 3323-24.

68. A total of 224 land classification holes were drilled in the historic project areas. Tr. 3552.

69. Thirty infiltration tests were run on the historic project lands. United States Exhibit WRIR C-226, p. 10.

70. A drainage investigation was conducted by Robert Toedter on the historic project lands that were idle to determine the capability of draining those lands with existing or potential high water tables. United States Exhibits WRIR C-226, p. 11, WRIR C-237 through WRIR C-240, WRIR C-237A through WRIR C-240A, WRIR-C-241B, Tr. 3744-46, 3751-3829.

71. The soil characteristics identified in the drainage investigation were depth to barrier, hydraulic conductivity and texture. Barrier is defined as the depth where the hydraulic conductivity is one-tenth that of the soils lying above. United States Exhibit WRIR C-226, p. 11.

72. Most of the lands within the historic project areas are alluvial or colluvial with shale and sandstone forming the natural barrier. United States Exhibit WRIR C-226, p. 11.

73. Twelve hydraulic conductivity tests were run on representative textures of soils of geologic formations throughout the historic irrigation projects. United States Exhibit WRIR C-226, p. 12.

74. Twenty-six deep holes were bored, in conjunction with study of land forms, to determine average barrier depths over an area. United States Exhibit WRIR C-226, p. 11.

75. All results of the drainage investigations were sent to Stetson Engineers. Tr. 3823, United States Exhibit WRIR C-237 through WRIR C-240, WRIR C-241B.

76. Top soils in the alluvial or colluvial soils are medium textured ranging from sandy loams to sandy clay loams and are underlain by subsoils ranging from sandy loam to clay loam. The subsoils are typically sandy clay loams or sandy loams. United States Exhibit WRIR C-226, p. 11.

77. Terraces exhibit medium textured topsoils ranging from sandy loams to sandy clay loams and are underlain by graded gravelly subsoils. United States Exhibit WRIR C-226, p. 11.

78. Chemical analysis were run on soils in the historic project areas. The tests run were the same as described in H.K.M.'s future land classification study of the North Crowheart, South Crowheart, Big Horn Flats, Arapahoe and Riverton East units found in United States Exhibit WRIR C-43, p. 18-20. A total of 1,084 samples were analyzed. United States Exhibit WRIR C-226, pp. 12-13, Tr. 3324.

79. After the field programs in the historic project areas were completed, results of the drainage program and the laboratory analysis were evaluated and incorporated into the land classification. All pertinent information was then inked onto aerial photographs, and a quantification of arable trust acreages was made. United States Exhibit WRIR C-226, p. 13, Tr. 3333.

80. The historic arable land study area also consisted of those Type VII lands that meet the historic arable lands definition but lie outside of major irrigation projects. Lands on all major drainages on the reservation were studied. A field program similar to that for project lands was instituted to determine the arability of these non-irrigated lands. United States Exhibit WRIR C-226, p. 14, Tr. 3343, 5254, Wyoming Exhibit HB-8.

81. Non-project land classification standards were developed in an attempt to reflect the realities of present irrigation development in the area. Some lands in the basin will not meet the classification standards, but are currently being irrigated. Small isolated tracts do not generally require project drainage or extensive delivery systems, which allows relaxation of some classification criteria. Many currently irrigated lands in the basin are too cobbly or are too shallow to meet project criteria, but are being irrigated by private individuals. The non-project land classification standards take into account these conditions. United States Exhibit WRIR C-226, p. 14, Table 5, pp. 15, 16 and 17, Tr. 3336-41.

82. The potential historic arable lands that fell outside the historic projects were subject to a land classification program using site specific land classification standards. The field program was very similar to that inside the historic projects, with holes augered in the large tracts, as well as many of the small tracts and soils and topographic evaluations made. United States Exhibit WRIR C-226, p. 18, Tr. 3336-41.

83. A total of 147 land classification holes were drilled in the non-project areas. Tr. 3552.

84. Drainage requirements in the non-project historic areas were considered to be the responsibility of the operators. No separate drainage evaluation was performed on the non-project lands. Under the circumstances, this was a reasonable approach. United States Exhibit WRIR C-226, p. 18, Tr. 3340-41.

85. The chemical procedures and analytical methods used in the non-project historic lands are identical to those used for the historic project lands. United States Exhibit WRIR C-226, p. 18.

86. As a result of the historic land classification program there are in the major historic irrigation projects 0 acres of Class 1 land, 1,419 acres of Class 2 land, 4,408 acres of Class 3 land, 1,394 acres of Class 4 land, for a total of 7,221 arable acres. In the non-project study area there are 88 acres of Class 1 land, 1,279 acres of Class 2 land, 1,957 acres of Class 3 land, 1,594 acres of Class 4 land, for a total of 4,917 arable acres. This is a total of 12,138 acres of arable lands in the historic study area. United States Exhibit WRIR C-223, p. 39, Tr. 3345.

87. The results of the land classification of the Type VII and VIII, lands were sent to Stetson Engineers for their use. United States Exhibit WRIR C-56A - 136A, United States Exhibit WRIR C-227-1 through C-227-12, Tr. 5227, 5255, 5589.

88. Total historic arable lands within the major historic irrigation projects by land class are as follows:

PROJECT	GRAVITY 1	GRAVITY 2	GRAVITY 3	GRAVITY 4	SPRINKLER 1	SPRINKLER 2	SPRINKLER 3	SPRINKLER 4
Wind River Federal Irrigation Project								
Ray Canal	--	927	411	888	125	797	300	710
Coolidge Canal	--	222	965	576	36	217	713	514
Sub-Agency Canal	--	84	389	17	88	234	137	89
Subtotal	--	1233	1765	1481	249	1248	1150	1313
Upper Wind Unit								
Wind River "A" Canal	--	--	10	40	--	--	10	40
Dinwoody Canal	--	57	951	--	--	354	313	--
Subtotal	--	57	961	40	--	354	323	40
Johnstown Unit	--	--	289	138	--	164	--	138
Lefthand Unit	--	78	389	--	--	--	456	316
Wind River F.I.P. TOTAL	--	1368	3404	1659	249	1766	1929	1807
Midvale Irrigation District	--	--	--	--	--	--	--	--
Leclair Irrigation District	--	--	100	--	--	--	35	--
Wind River Indian Reservation Major Irrigation Projects GRAND TOTAL	--	1368	3504	1659	249	1766	1964	1807

	TOTAL ARABLE LANDS 1	2	3	4	PROJECT TOTAL
Wind River Federal Irrigation Project					
Ray Canal	--	927	411	925	2263
Coolidge Canal	--	222	1013	607	1842
Sub-Agency Canal	--	134	389	106	629
Subtotal	--	1283	1813	1638	4734
Upper Wind Unit					
Wind River "A" Canal	--	--	10	40	50
Dinwoody Canal	--	57	951	--	1008
Subtotal	--	57	961	40	1058
Johnstown Unit	--	--	289	138	427
Lefthand Unit	--	78	508	316	902
Wind River F.I.P. TOTAL	--	1418	3571	2132	7121
Midvale Irrigation District	--	--	--	--	-0-
Leclair Irrigation District	--	--	100	--	100
Wind River Indian Reservation Major Irrigation Projects					
GRAND TOTAL	--	1418	3671	2132	7221

89. Totals for historic arable lands in the non-project area by land class are:

DRAINAGE	1	2	3	4	TOTAL
WIND RIVER BASIN					
East Fork Wind River	--	--	--	104	104
Dinwoody Creek	--	--	--	27	27
Sand Draw	--	--	--	73	73
Dry Creek	--	--	4	--	4
Bull Lake Creek	--	37	--	--	37
Meadow Creek	--	--	159	--	159
Dry Pasup Creek	--	61	68	66	195
Crow Creek	--	36	106	83	225
Willow Creek	--	--	--	--	0
Main Stem Wind River	--	109	105	--	214
Subtotal	--	243	442	353	1038

DRAINAGE	1	2	3	4	TOTAL
LITTLE WIND BASIN					
North Fork Little Wind River	--	70	128	336	534
South Fork Little Wind River	--	--	29	36	65
Main Stem Little Wind River	--	377	332	96	805
Mill Creek	--	--	--	10	10
Sage Creek	--	--	822	95	917
Crooked Creek	--	--	--	79	79
Trout Creek	--	--	--	86	86
Spring Creek	--	--	--	7	7
Bighorn Draw	--	--	--	87	87
Subtotal	--	447	1311	832	2590
BIGHORN BASIN					
Mainstem Bighorn River	--	24	--	--	24
Cottonwood Creek	--	54	23	40	117
Fivemile Creek	--	--	--	--	0
Muddy Creek	60	80	70	87	297
Subtotal	60	158	93	127	438
POPO AGIE BASIN					
North Fork Popo Agie River	--	--	88	343	431
Main Stem Popo Agie River	--	--	--	--	0
Subtotal	--	--	88	343	431
OWL CREEK BASIN					
South Fork Owl Creek	--	53	11	8	72
Main Stem Owl Creek	--	136	--	--	136
Mud Creek	28	92	3	--	123
Red Creek	--	--	--	89	89
Subtotal	28	281	14	97	420
WIND RIVER INDIAN RESERVATION NON-PROJECT GRAND TOTALS	88	1129	1948	1752	4917

90. Totals of historic arable lands in the non-project area, by gravity and sprinkler classification on a tract by tract basis are set forth in United States Exhibit WRIR C-226, Table 7, pp. 29-38.

91. The State of Wyoming did not employ or utilize any drainage engineer in their analysis of arable lands on the Wind River Indian Reservation. Tr. 10782, 10721.

92. Mr. Clarence Fowkes, a witness for the State of Wyoming regarding soils, had no previous experience in determining soil arability. Tr. 10679-80.

93. Mr. Craig Sommers, a witness for the State of Wyoming regarding soils, had very limited experience regarding the determination of soil arability, and thus was not competent to evaluate the H.K.M. semi-detailed land classification. Tr. 10771-84.

94. Mr. Sommers and Mr. Fowkes performed no more than 25 days of field work on the Wind River Indian Reservation, and made only approximately 50 soil observations. They conducted no field work in regard to the Type VII and VIII lands. It was not reasonable for them to exclude land as being non-arable that they did not analyze in the field. Tr. 11034-35, 11127.

IV. ENGINEERING STUDIES, WATER DUTIES AND COST ESTIMATES FOR FUTURE PROJECTS, ADJUDICATED, UNADJUDICATED IN USE AND TYPE VII, TYPE VIII, AND THE OWL CREEK UNIT

A. Future Projects

95. Testimony regarding the design of irrigation facilities to serve the future projects, the costs of those projects, the irrigation requirements and the diversion requirements of the future projects was presented by Dr. Woldezion Mesghinna of Stetson Engineers. Dr. Mesghinna was qualified to express expert opinions in these areas and the State of Wyoming did not object to his rendering opinions in these technical specialties. Tr. 4014.

96. The "future project" lands lie outside the boundaries of the Wind River Federal Irrigation the Midvale Irrigation District and the LeClair Irrigation District Project and have no history of irrigation. The boundaries of the future projects, and the arable land base within those boundaries, were determined by H.K.M. Associates under the direction of A. T. Kersich. See Findings 15, through 94.

97. The future project lands are divided into six proposed project units. These are the North Crowheart Unit, the South Crowheart Unit, Big Horn Flats Unit, the Arapahoe Unit, the Riverton East Unit, and Owl Creek Unit.

98. The North Crowheart Unit is located in the central portion of the reservation. Under the plan proposed by Dr. Mesghinna the source of water for this unit will be the Big Wind River. The diversion point for the project will be at a point on the river about 2.5 miles north of Crowheart. United States Exhibit WRIR C-245, p.24.

99. The proposed South Crowheart Unit is located between the Wind and the Little Wind Rivers west of Riverton. Under Dr. Mesghinna's plan it would divert water from the Wind River. United States Exhibit WRIR C-245, p.27.

100. The Arapahoe Unit lies between the Little Wind and the Popo Agie, westerly of the confluence of the two rivers. The irrigable lands in this proposed unit would be served by the proposed Arapahoe Canal, which would divert water from the North Fork of the Popo Agie River. United States Exhibit WRIR C-245, p. 27.

101. The proposed Riverton East Unit is situated in the southeastern portion of the reservation. A portion of the arable lands would receive water by direct pumping from the Little Wind [4/] and the Wind Rivers, [5/] and some of the irrigable lands would receive water from the Wind River [5/] through the proposed Riverton East Canal. United States Exhibit WRIR C-245, p.30.

102. A portion of the Big Horn Flats Unit lies just south of the proposed North Crowheart Unit, south of the Wind River, while the rest is located just west of Ethete. The proposed Big Horn Flats Unit will receive most of its water from the Wind River and some water from the Little Wind River. United States Exhibit WRIR C-245, 30, 32.

4/ The reach of stream here referred to as the Little Wind River is that length of river system below the confluence of the Popo Agie River with the Little Wind River yet above the confluence of the Wind River with the Little Wind River.

5/ The stretch of river here identified as Wind River is the reach below the confluence of the Wind River with the Little Wind River. This is called the Big Horn River in the system operation study.

103. The Owl Creek Unit is a small project and was discussed by Dr. Mesghinna in conjunction with his testimony regarding Type VIII land. Findings regarding Owl Creek are therefore included among the findings regarding Type VIII lands.

104. The proposed future projects are designed to irrigate arable lands identified and classified as arable by Mr. Kersich of H.K.M. Associates. All lands to be irrigated by the proposed irrigation projects have been classified as Class 1, 2, or 3 for sprinkler irrigation purposes. Tr. 4153. These lands lie in large contiguous blocks, making large irrigation projects attractive and feasible. These lands have no history of irrigation.

105. In order to determine whether any of the future project arable lands, as identified by H.K.M., are technically irrigable from an engineering point of view it was necessary for Dr. Mesghinna to study eleven factors: (1) the climate of the area; (2) the crops and cropping pattern of the Wind River Indian Reservation; (3) evapotranspiration (that is, the amount of water evaporated from the land on an irrigated field and the amount of water transpired by the plant); (4) the on-farm system design of facilities necessary to supply sufficient water to the crop; (5) the pipe network design to supply water to the on-farm system; (6) pump and pumping plant design to move water through the pipe network

and to the on-farm system; (7) canals and related structures, such as diversion structures, syphons, and drop structures, to move water from natural streams to the pumping stations; (8) subsurface and surface drainage to insure that there will be no damage from water buildup resulting from irrigation application and seepage from the canals; (9) operation and maintenance of the projects; (10) diversion requirements or water duties; and (11) costs. Tr. 4017-4023.

106. Based on existing data from seven weather stations maintained on or near the Wind River Indian Reservation by the National Oceanic and Atmospheric Administration and soil temperature studies of the reservation developed by the Soil Conservation Service, Dr. Mesghinna identified seven climate zones (Diversion Dam, Fort Washakie, Riverton, Pavillion, Lander, Burris and DuBois) on the reservation and placed the boundary of each zone. No witness who testified on behalf of the State disagreed with the manner in which these climate zones were established or utilized; indeed the State's witnesses accepted and utilized Dr. Mesghinna's data and results. A map showing the location of these zones was admitted into evidence as United States Exhibit WRIR C-244. Tr. 4024-43.

107. A proposed cropping pattern for the future projects was developed by Mr. Dornbusch with considerable input from Dr. Mesghinna. This cropping pattern was based on the climate, the preference of local farmers as developed through farmer interviews and discussions with local agricultural extension agents undertaken by the economists, and economic returns from such crops. Tr. 4045-57.

108. As a result of the aforesaid study it was determined that the cropping pattern above 5900 feet in elevation would differ from the cropping pattern below that elevation. The pattern below 5900 feet is: 67 percent alfalfa, 12 percent corn, 6 percent small grain nursing alfalfa and 5 percent small grain. The pattern above 5900 feet is: 67 percent alfalfa, no corn, 16 percent small grain nursing alfalfa, and 17 percent small grain. United States Exhibit WRIR C-245, p. 7, Tr. 4563.

109. Having developed the climate zones and the cropping pattern, Dr. Mesghinna developed the crop water requirements. The first step in this process is to determine "evapotranspiration". Tr. 4066.

110. Dr. Mesghinna determined the evapotranspiration of each crop in the cropping pattern. Crop evapotranspiration is defined as the water evaporated from the soil and the water transpired by the crop. Initially "potential evapotranspiration" was determined. "Potential evapotranspiration" is determined by analysis of a "reference" crop (such as alfalfa) defined as a well-watered crop having uniform height and completely covering the ground. The evapotranspiration of the reference crop was determined by use of the modified Jensen-Haise equation -- a formula accepted in the field of agricultural engineering. The witnesses testifying on behalf of the State of Wyoming also utilized the Jensen-Haise formula and had no quarrel with the results of the work done by Dr. Mesghinna. Tr. 4066-75.

111. Once the "potential evapotranspiration" for the reference crop was determined, Dr. Mesghinna determined the evapotranspiration for each particular crop in the cropping pattern by application of "crop coefficients" developed for crops growing in the Midvale Irrigation District within the boundaries of the reservation. Dr. Mesghinna determined the actual evapotranspiration of each crop in the cropping pattern for each climatic zone, and for each month of the growing season. The determination made by Dr. Mesghinna of the evapotranspiration requirements of each crop in the cropping pattern was not challenged by the witnesses who testified on behalf of the State of Wyoming. Tr. 4081-87.

112. Having determined the amount of water necessary to meet the evapotranspiration requirements of each crop, Dr. Mesghinna determined how much of that requirement could be met by rainfall, and the resulting irrigation requirement. Since some rainfall is lost through deep percolation below the root zone of the crop and

by surface runoff, Dr. Mesghinna had to determine "effective precipitation", that is the portion of monthly precipitation effectively stored in the soil root zone and consequently directly used by the crop. Dr. Mesghinna used the Soil Conservation Service's Technical Release No. 21 to determine effective precipitation from the long term mean monthly rainfall records at each of the weather stations. The effective precipitation was developed for each crop for each climatic zone. Dr. Mesghinna's determination of effective precipitation was not disputed by the witnesses for the State of Wyoming. Tr. 4088-4091.

113. Having determined the evapotranspiration and the effective precipitation for each crop in the cropping pattern, for each climatic zone, and for each month in the growing season, Dr. Mesghinna calculated the net irrigation requirement for each crop, each climate zone, and each month of the growing season. The net irrigation requirement is merely the difference between the

evapotranspiration requirement and effective precipitation. The State of Wyoming's witnesses did not disagree with Dr. Mesghinna's calculations of the net irrigation requirement for his cropping pattern. United States Exhibit WRIR C-245, p. 10.

114. Once the net irrigation requirement for each crop for each climate zone and for each month of the irrigation season was determined, Dr. Mesghinna developed a weighted average net irrigation requirement for each of the future projects. This merely means that, based on the amount of acres in each climatic zone within a project, and the amount of acreage above 5900 feet and then the amount of acreage below 5900 feet within the project, an average net irrigation requirement per acre was developed for each project. The State's witnesses do not disagree with this average net irrigation requirement for Dr. Mesghinna's cropping pattern. Tr. 4088-91.

115. Having determined the average net irrigation requirement for each of the projects, Dr. Mesghinna designed an irrigation system to convey water from existing streams to the fields on which the crops are to be grown. Since some water will be lost in transporting the water from the stream to the crop, the amount of water taken from the stream (the diversion requirement) will always exceed the amount of irrigation water used by the crop ("net irrigation requirement"). United States Exhibit WRIR C-245, p. 11.

116. While the State of Wyoming's economists dispute that the irrigation system designed by Dr. Mesghinna is economically feasible, the State's engineering witnesses did testify that Dr. Mesghinna's designs were feasible and appropriate from an engineering standpoint. Tr. 12157. In addition, the State's engineers (at the request of the State's counsel) employed an outside consultant to review Dr. Mesghinna's work and that consultant also concurred the plans were feasible. Tr. 12187.

117. The soil characteristics of each tract of arable land in the future projects had been developed by the soils experts (H.K.M. Associates) employed by the United States. This soils information was taken by Dr. Mesghinna and transferred to work maps and he then developed farm field layouts. Tr. 4128-30. Based on the soils information, Dr. Mesghinna developed, for each individual field, its water holding capacity (that is the amount of water the soil root zone could store) and the intake rate (that is the rate at which water applied to the surface will infiltrate the soil). Soil with a high water holding capacity retains its water longer than soil with a low water holding capacity and therefore does not need to be irrigated as frequently. If soil has a low intake rate, it takes a longer period of time to apply the necessary irrigation water. Hence, soils with a low intake rate require a sprinkler to remain in place for a longer period of time to apply the necessary amount of water. The State's consultants did not challenge the water holding capacities and the intake rates assigned to each field by Dr. Mesghinna. Tr. 4109-4143.

118. Based on the cropping pattern, Dr. Mesghinna assigned a weighted effective root depth of 4.5 feet. Tr. 4121-23. He also assigned a soil water depletion of 50 percent. Tr. 4138-39. This means that once the crop has consumed 50 percent of the water in the root zone it will be necessary to apply additional irrigation. Tr. 4138. The root depth and the soil water determinations made by Dr. Mesghinna were not challenged by the witnesses who testified on behalf of the State of Wyoming.

119. Having determined the water holding capacity, the intake rate, the weighted effective root depth, and the soil water depletion for each field or farm, Dr. Mesghinna was able to determine the frequency of application for each field. That is, he determined how frequently water had to be applied to a particular portion of the field during the period of peak consumptive use of water. The more frequently a field needs to be irrigated, the more irrigation laterals are needed for that field. Tr. 4151-62. The State of Wyoming's witness did not dispute Dr. Mesghinna's

determinations of frequency of applications. Among other things, the frequency of irrigation enables one to determine the number of laterals necessary for a given field. Tr. 4160-61. Knowing the frequency of irrigation and peak consumptive use, Dr. Mesghinna was able to determine the amount of water which must be applied to a particular field to fulfill the crops' net irrigation requirement. The State's witnesses expressed no disagreement with Dr. Mesghinna's determination of the net water required to be applied to each field to fulfill net irrigation requirement for Dr. Mesghinna's cropping pattern.

120. Once Dr. Mesghinna had determined the amount of water that was required to reach each field to satisfy the net irrigation requirement, he determined the "application efficiency". Application efficiency is merely a percentage figure that expresses the net amount of water that reaches the soil as compared to the amount of water delivered to the farm head gate. United Exhibit WRIR C-245, p.11. Dr. Mesghinna's on-farm system design calls for either hand moved or side roll sprinklers in all instances. This type of on-farm irrigation system is more efficient than a gravity irrigation system. Having developed the amount of water necessary to be applied (net irrigation requirement) at the farm level and utilizing the average wind velocity and the peak consumptive use of water, Dr. Mesghinna then computed an on-farm application efficiency using the method set out in the Irrigation Handbook by Lockwood Ames, published in 1973. United States Exhibit WRIR C-245, p. 11-12. No consultant who testified on behalf of the State of Wyoming

challenged Dr. Mesghinna's methodology or his results, demonstrating a 67 percent on-farm efficiency for all future projects other than Riverton East, which has a 66 percent efficiency. In order to determine the amount of water that must be delivered to each farm head gate (gross water requirement), Dr. Mesghinna divided the amount of water necessary to be applied to the field (net water requirement) to satisfy the net irrigation requirement by .67 (.66 in the case of the Riverton East Unit). United States Exhibit WRIR C-245, p. 11-12. None of the State of Wyoming's witnesses disagreed with Dr. Mesghinna's determination of the amount of water necessary to be delivered to the farm to satisfy the net application water needs.

121. Dr. Mesghinna designed, for each of the proposed future projects, a pipe distribution system to transport irrigation water from the canals designed for each of the units to the head gate of the individual farms. The distribution system, or pipe network, consists entirely of enclosed buried pipe. Since very little water is lost while being transported in the enclosed pipes, Dr. Mesghinna assigned a 95 percent efficiency to the distribution system ("distribution efficiency"). In order to determine the amount of water that must be removed from the main canals at the head of each pipe distribution system, Dr. Mesghinna divided the amount of water that must be delivered to the farm head gate by .95. The use of 95 percent distribution efficiency was not challenged by the State's witnesses. Tr. 4169-4181.

122. At the head of each pipe distribution system, Dr. Mesghinna designed a pump and pumping plant to move water from the canals through the pipe distribution system. Dr. Mesghinna's design of these pumps has not been challenged, although the Tribes' witnesses believe that Dr. Mesghinna's costs estimates for these pumps is too high. Tr. 4181-94.

123. For each proposed future unit (other than Big Horn Flats), Dr. Mesghinna designed a canal system to transport water from the point of diversion to the pumps that head up the pipe distribution system (in some cases where diversion of water via a canal is impractical, direct pumping from the river source is proposed). The canal or conveyance efficiency is the ratio of water delivered to the pump stations compared to the amount diverted from the source. Dr. Mesghinna determined the conveyance efficiency for each reach of his canals, a reach being generally defined as the stretch of canal between pump stations. The conveyance efficiency depends on the length of a canal, the flow in the canal, amount of wetted perimeter, canal soil characteristics, operation losses and other factors. By use of the Moritz formula, a formula generally accepted by agricultural engineers, Dr. Mesghinna determined the conveyance efficiencies for all canals on a monthly basis from May to September. The North Crowheart Canal efficiency varies from a low of 69 percent in May to a high of 77 percent in July. The South Crowheart Canal efficiency varies from a low of 68 percent in May

to 75 percent in July. Arapahoe Canal's lowest efficiency is 63 percent in May and its highest is 72 percent in July. Riverton East Canal's lowest efficiency is 60 percent in May and its highest is 69 percent in July. The Big Horn Flats unit has no canals in the proposed design since water is pumped directly from the river into the pipe distribution system. Tr. 4227-38, United States Exhibit WRIR C-245, p. 15.

124. Having determined the net amount of water that must be applied to the crops, the on-farm efficiency, the distribution efficiency, and the conveyance efficiency, Dr. Mesghinna was able to determine, for each of the future projects, the amount of water that needs to be diverted from the stream in order to fulfill the crop water requirements. For each project, Dr. Mesghinna determined the monthly diversion requirement for the number of net acres in each climatic zone served by each diversion point, the total seasonal diversion requirement for those acres, and a seasonal unit diversion requirement expressed in acre feet of water diverted per acre of land served. In addition, Dr. Mesghinna determined for each unit the total net acreage, the total diversion requirement for each month of the irrigation system, the total seasonal diversion requirement, and an overall unit diversion requirement. Tr. 4234-38, United States Exhibit WRIR C-245, pp. 24-33.

125. Dr. Mesghinna designed a drainage system for each of the future projects in order to protect the farm units from any adverse effect that might result from a rise in the water table occurring because of the application of irrigation water and also to avoid any damage to non-project lands from the proposed irrigation of the project lands. Tr. 4242-65. The witnesses for the State of Wyoming had no criticism of Dr. Mesghinna's drainage plans.

126. Dr. Mesghinna estimated the costs of building the five future projects. He divided his cost into "investment costs" and "operation costs". Investment costs include the costs of the on-farm system, the pipe distribution system, the pumps and pumping plants, the canals and related structures, drainage, and engineering and contingencies. The operation costs include operation and maintenance, energy costs, and demand costs. United States Exhibit WRIR C-245, p. 42.

Dr. Mesghinna determined the total costs of each of the projects and the costs of each project on a per acre of irrigated land basis. Tr. 4327-31, United States Exhibit C-245, p. 42.

127. The costs were turned over by Dr. Mesghinna to Mr. Dornbusch, an economist employed as a consultant by the United States.

128. The net acreage in each unit does not include all of the lands within each unit found to be arable by H.K.M. Associates.

It includes only those lands which can be irrigated by their inclusion within one of the farm layouts designed by Dr. Mesghinna. Dr. Mesghinna excluded arable lands from his on-farm system design where the slope of such lands was too steep to irrigate by his sprinkler system, where a parcel was too small to justify the design of on-farm system, and where similar engineering consideration prevented the inclusion of arable lands within the irrigation system design. Dr. Mesghinna also excluded, from his net acreage, arable lands for which he had designed an irrigation system that was feasible from an engineering standpoint but which, according to the advice given to him by the expert economist employed by the United States, could not be practicably irrigated from an economic standpoint since, in the economist's view, the per acre economic cost of irrigating the land exceeded the anticipated per acre economic return. Once the reduction in acreage based on engineering concerns and economic concerns had been made, Dr. Mesghinna reduced the remaining acreage by 5 percent in order to take into account arable lands which would be used for farmsteads, roads and similar manmade structures if the projects were constructed. The remaining total arable acres are called "net irrigable acres". The water requirements determined for the future projects by Dr. Mesghinna are based on these net irrigable acres. Tr. 4287-90.

129. The North Crowheart unit contains 38,773 net irrigable acres. These acres lie in either the Burris, Diversion Dam or Pavillion climate zones. The diversion requirement is 147,767 acre

feet of water per year. The unit diversion requirement is 3.81 acre feet of water per acre of irrigated land. The water would be diverted from the Wind River at a point about 2.5 miles north of Crowheart. United States Exhibit WRIR C-245, p.24-6.

130. The South Crowheart Unit contains 4,695 net irrigable acres, which lie in either the Pavillion or Riverton climate zone. The annual diversion requirement is 20,137 acre feet of water and the weighted average unit diversion requirement is 4.29 acre feet of water per acre. The water would be diverted from the Big Wind River. United States Exhibit WRIR C-245, pp. 27-8.

131. In the Arapahoe unit there are 3,808 net irrigable acres, lying in the Lander or Pavillion climate zones. The annual diversion requirement is 16,720 acre feet of water. The weighted average unit diversion requirement is 4.39 acre feet per acre. Water for the Arapahoe Unit would be diverted from North Fork of the Popo Agie. United States Exhibit WRIR C-245, pp. 27, 29.

132. In the Big Horn Flats unit there are 2,670 net irrigable acres. Of these acres, 968 acres lie in the Fort Washakie climate zone and would receive water from the Little Wind River.

The annual diversion requirement for these 968 acres is 2,464 acre feet of water and the unit diversion requirement is 2.55 acre feet per acre. The remaining 1,702 acres lie in either the Diversion Dam or the Burris climatic zone. The diversion point for these lands is on the Wind River. The annual diversion requirement for these 1,702 acres is 4,748 acre feet of water. The weighted average unit diversion requirement is 2.79 acre feet of water per acre. United States Exhibit WRIR C-245, pp. 30, 33.

133. In the Riverton East Unit there are 3,814 net irrigable acres. All of these acres are in the Riverton climate zone. One hundred fifty seven acres would receive water by direct pumping from the Little Wind River; the unit diversion requirement for these lands is 3.16 acre feet per acre and the seasonal diversion requirement 496 acre feet. Two hundred seventy two acres receive water pumped from the Wind River.[6/] The unit diversion requirement for these lands is also 3.16 acre feet per acre. The seasonal diversion requirement is 861 acre feet. Three thousand three hundred eighty five acres would receive water from a proposed Riverton East Canal from the Wind River.[6/] The unit diversion requirement for these lands is 4.78 acre feet per acre. The total seasonal diversion requirement is 16,179 acre feet. The total seasonal diversion requirement for the Riverton East Unit is 17,536 acre feet of water. United States Exhibit WRIR C-245, pp. 30-31.

134. The future projects require a seasonal diversion of 189,692 acre feet of water from the Wind River,[7/] 16,720 acre feet of water from the Popo Agie, and 2,960 acre feet of water from the Little Wind.

6/ The reach of stream identified here as the Wind River is also called the Big Horn River which is described as that stretch of river system below the confluence of the Wind with the Little Wind River. This conforms with the terminology used in the United States' system operation study.

7/ Under the definitions applied in the system study, 172,652 acre-feet are diverted on a seasonal basis from the Wind River and 17,040 acre-feet from the Big Horn River.

B. Adjudicated, Unadjudicated In Use And Type VII Lands

135. Testimony on the engineering studies, water requirements and relevant to the adjudicated, unadjudicated in use and Type VII trust land was presented by Thomas Stetson, president of Stetson Engineers, Inc., and a qualified expert in the field of irrigation system design. Mr. Stetson also presented testimony of the costs of bringing the Type VII lands into irrigation.

136. The Wind River Federal Irrigation Project is comprised of the Upper Wind Unit (which is made up of the Wind River bottom lands served by the Wind River "A" canal and the Dinwoody Bench area) on the Wind River, the Little Wind Unit (which is made up of the Ray Unit, the Coolidge Unit and the Subagency Unit) on the Little Wind River, and the Johnstown Unit and the Lefthand Unit on the main stem of the Wind River. There are also trust lands served by the LeClair Irrigation District and the Midvale Irrigation District. Tr. 5222-25, Wyoming Exhibit WRIR HS-3.

137. The Upper Wind Unit is served mainly from the Wind River and Dinwoody Creek. Supplemental water is supplied from Dry Creek, Meadow Creek and Willow Creek. Wyoming Exhibit WRIR HS-3. The Johnstown and Lefthand Units are served from the Wind River. Wyoming Exhibit WRIR HS-3. The Ray, Coolidge and Subagency Units are served by the North Fork of the Little Wind, the South Fork of the Little Wind River, the main stem of the Little Wind River, Trout Creek and Mill Creek. Midvale and LeClair Irrigation Districts are served from the Wind River. Wyoming Exhibit WRIR HS-3.

138. The Bureau of Indian Affairs has maintained records showing the acreages irrigated by the Wind River Irrigation Project and the annual diversion requirements for those lands. Records of a similar nature are maintained by the Midvale and LeClair Irrigation Districts. Tr. 5228-29.

139. In the Ray Unit, the records indicate that, on the average, 5.32 acre feet of water were diverted annually from the stream to serve each acre of irrigated land. Tr. 5231, Wyoming Exhibit WRIR HS-3.

140. In the Ray Unit there are 347 acres of trust land having adjudicated water rights. Based on an average annual diversion of 5.32 acre feet of water for each acre of irrigated land, the annual diversion requirement for the trust lands having adjudicated water rights in the Ray Unit is 1,846 acre feet of water. Tr. 5231, Wyoming Exhibit WRIR HS-3.

141. The records for the Coolidge Unit indicate that the average annual diversion requirement is 4.95 acre feet of water for each acre of irrigated land. There are 311 acres of trust land in the Coolidge Unit that have adjudicated water rights. The annual diversion requirement to serve these trust lands is 1,539 acre feet of water. Tr. 5231, Wyoming Exhibit WRIR HS-3.

142. There are no trust lands in the Subagency Unit or in the Wind River A canal of the Upper Wind Unit that

have adjudicated water rights. Tr. 5231, Wyoming Exhibit WRIR HS-3.

143. The average annual diversion requirement for the Dinwoody Bench area of the Upper Wind Unit is 12.06 acre feet of water per irrigated acre. There are 492 acres of trust lands with adjudicated water rights in the Dinwoody Bench area. The annual diversion requirement for the trust lands having an adjudicated water right in the Dinwoody Bench area is 5,934 acre feet. Tr. 5231, Wyoming Exhibit WRIR HS-3.

144. There are no trust lands in the Johnstown Unit with adjudicated water rights. Tr. 5231, Wyoming Exhibit WRIR HS-3.

145. In the Lefthand Unit the average annual diversion requirement is 6.9 acre feet of water for each acre served. There are twenty acres of trust land in the Lefthand Unit that have adjudicated water rights. The annual diversion requirement for these lands is 138 acre feet of water. Tr. 5231, Wyoming Exhibit WRIR HS-3.

146. There are no trust lands in either the LeClair or Midvale Irrigation Districts having adjudicated water rights. Tr. 5232, Wyoming Exhibit WRIR HS-3.

147. For the total 1170 acres of trust land with adjudicated water rights within the irrigation project areas the total annual diversion requirement is 9,457 acre feet. Tr. 5232, Wyoming Exhibit WRIR HS-3. (See Findings 139-146.)

148. In the Ray Unit, there are 7,782 acres of unadjudicated trust land currently receiving water. Based on the per acre diversion requirement of 5.32 acre feet per acre the diversion requirement for these trust lands is 41,400 acre feet per year. Tr. 5234,[8/] Wyoming Exhibit WRIR HS-5.

149. In the Coolidge Unit there are 6,357 acres of trust land currently receiving water but having no adjudicated water right. Since the diversion requirement is 4.95 acre feet of water per acre per year, the annual diversion requirement is 31,467 acre feet. Tr. 5235,[9/] Wyoming Exhibit WRIR HS-5.

150. In the Subagency Unit there are 2,962 acres of trust land currently receiving water but having no adjudicated water rights. The average annual diversion requirement is 5.26 acre feet per acre. Therefore the diversion requirement for the 2,962 acres is 15,580 acre feet of water per year. Tr. 5235, Wyoming Exhibit WRIR HS-5.

151. In the Upper Wind Unit, where water is diverted from the Wind River "A" canal, there are 1,019 acres of trust

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8/ The transcript reads that there are "782,000 acres". This is an obvious error.

9/ The transcript says the diversion requirement is 4.59. This is either a reporting error or a slip of Mr. Stetson's tongue.

land currently receiving water with no adjudicated water right. Since the average annual diversion requirement is 12.06 acre feet of water per acre, the annual diversion requirement is 12,289 acre feet of water. Tr. 5235, Wyoming Exhibit WRIR HS-5.

152. In the Dinwoody Bench area of the Upper Wind Unit, there are 4,611 acres of trust land currently receiving water without an adjudicated water right. Since the average annual diversion requirement is 12.06 acre feet per acre, the annual diversion requirement for these lands is 55,609 acre feet. Tr. 5255, Wyoming Exhibit WRIR HS-5.

153. In the Johnston Unit there are 465 acres of trust land without an adjudicated water right currently receiving water. The average annual diversion requirement is 6.94 acre feet per acre. The annual diversion requirement for these 465 acres is 3,227 acre feet of water. Tr. 5235, Wyoming Exhibit WRIR HSO-5.

154. In the Lefthand Unit, there are 1,541 acres of trust land currently receiving water although they have no adjudicated water right. The average annual diversion requirement for the Lefthand Unit is 6.9 acre feet per acre. For these 1,541 trust acres the annual diversion requirement is 10,633 acre feet of water. Tr. 5235, Wyoming Exhibit WRIR HS-5.

155. In the Midvale Irrigation District there are 569 acres of trust land currently receiving water although they have no adjudicated water right. The records of the Midvale Irrigation

District show that the annual diversion requirement is 5.58 acre feet per acre. Therefore for the 569 acres the annual diversion requirement is 3,175 acre feet of water. Tr. 2535, Wyoming Exhibit WRIR HS-5.

156. There are 1,271 acres of trust land in the LeClair Irrigation District that currently receive water although they have no adjudicated water right. The records of the LeClair Irrigation District show that the annual diversion requirement is 5.48 acre feet of water per acre of irrigated land. Therefore the annual diversion requirement for 1,271 acres is 6,965 acre feet of water. Tr. 5235, Wyoming Exhibit WRIR HS-5.

157. Within the project areas there are a total of 26,577 acres of trust land receiving water without an adjudicated water right. The total diversion requirement for these 26,577 acres is 180,345 acre feet of water per annum. Tr. 5236, Wyoming Exhibit WRIR HS-5. (See Findings 148-156.)

158. In the project areas, the average overall efficiency is 34.7 percent if the Upper Wind Unit is excluded. Tr. 5238. The State of Wyoming's experts agree that the average overall efficency is 35 percent.

159. It is proper to exclude the Upper Wind Unit from the calculation of the average overall efficiency of the project since the diversion requirement on the Upper Wind Unit historically has been extremely high.

160. Since the average overall efficiency of the project lands is 34.7 percent, it is proper to assume a 35 percent efficiency for historically irrigated lands outside the project areas. Tr. 5238-39.

161. With the aid of aerial photos, and the climate zone maps developed by Dr. Mesghinna, Mr. Stetson determined the location of historically irrigated trust lands outside the projects the climate zone in which they lie, and the appropriate cropping pattern. From that information Mr. Stetson derive the net irrigation requirement for each area. By multiplying the net irrigation requirement by the inverse of the overall efficiency of 35 percent, the diversion requirement for the historically irrigated trust lands outside the project areas was derived. Tr. 5240-41.

162. On the East Fork of the Wind River there are 259 trust lands with an adjudicated water right lying outside any of the existing irrigation projects. The diversion requirement for these lands is 5.06 acre feet of water per acre per year and the total annual diversion requirement is 1,310 acre feet of water. Tr. 5252, Wyoming Exhibit WRIR HS-3.

163. On Dinwoody Creek there are 17 acres of trust land with adjudicated water rights. These lands are outside the boundaries of an existing irrigation project. The diversion requirement for these lands is 5.57 acre feet per acre per annum. The total annual diversion requirement is 95 acre feet of water. Tr. 5242, Wyoming Exhibit WRIR HS-3.

164. On Meadow Creek there are 166 acres of trust land having adjudicated water rights and lying outside the boundary

of an irrigation project. The diversion requirement for these lands is 5.43 acre feet per acre per year. The total annual diversion requirement from Meadow Creek to serve these lands is 901 acre feet. Tr. 5242, Wyoming Exhibit WRIR HS-3.

165. On Dry Pasup Creek there are 1,977 acres of trust land having adjudicated water rights and lying outside the boundaries of an irrigation project. The diversion requirement is 5.31 acre feet per acre per annum. The total diversion requirement is 10,498 acre feet per year from Dry Pasup Creek. Tr. 5242-3,[10/] Wyoming Exhibit WRIR HS-3.

166. On Crow Creek there are 2,927 acres of trust land having adjudicated water rights but lying outside the boundaries of an irrigation project. The diversion requirement for these lands is 5.31 acre feet per acre per annum. The annual diversion requirement from Crow Creek is 15,542 acre feet. Tr. 5243,[11/] Wyoming Exhibit WRIR HS-3.

167. On Willow Creek there are 60 acres of trust land with adjudicated water rights but lying outside the boundaries of an irrigation project. The diversion requirement for these

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10/ The transcript reads 10,490 acre feet, rather then 10,498 acre feet. HS-3 and the arithmetic demonstrate that the correct figure is 10,498 acre feet.

11/ The transcript erroneously reads that the diversion requirement is 5.13.

acres is 5.57 acre feet per acre per year. The total annual diversion requirement from Willow Creek for these lands in 334 acre feet. Tr. 5243, Wyoming Exhibit WRIR HS-3.

168. On the main stem of the Wind River there are 1,338 acres of trust lands having adjudicated water rights and lying outside the boundaries of an irrigation project. The diversion requirement is 5.54 acre feet per acre per annum. The total annual diversion requirement for these lands from the main stem of the Wind River is 7,413 acre feet. Tr. 5243, Wyoming Exhibit WRIR HS-3.

169. As shown by Findings 162 through 168, in the Wind River Basin there are 6,744 acres of trust land with adjudicated water rights but lying outside the boundaries of an irrigation project. The total annual diversion requirement for these lands is 36,093 acre feet of water. Tr. 5243, Wyoming Exhibit WRIR HS-3.

170. There are trust lands having adjudicated water rights but lying outside any irrigation project boundaries on four tributaries of the Little Wind: the North Fork, the South Fork, Sage Creek and Mill Creek. Tr. 5244.

171. On the North Fork there are 485 trust acres with adjudicated rights lying outside the boundaries of an irrigation project. The diversion requirement is 5.49 acre feet of water per acre per annum. The total annual diversion requirement from the North Fork for these acres is 2,663 acre feet of water. Tr. 5244, Wyoming Exhibit WRIR HS-3.

172. On the South Fork of the Little Wind there are 107 acres of trust lands with adjudicated water rights lying outside the boundaries of an irrigation project. The diversion requirement for these lands is 4.94 acre feet per acre per annum. The total diversion requirement for these lands is 529 acre feet per year from the South Fork of the Little Wind. Tr. 5244, Wyoming Exhibit WRIR HS-3.

173. On Sage Creek there are 207 acres of trust lands with adjudicated water rights lying outside the boundaries of an irrigation project. The diversion requirement for these lands is 5.57 acre feet per acre per annum. The total diversion requirement from Sage Creek to serve these trust lands is 1,153 acre feet per year. Tr. 5244, Wyoming Exhibit WRIR HS-3.

174. On Mill Creek there are 37 acres of trust land with adjudicated water rights lying outside the boundaries of an irrigation project. The average diversion requirement for these lands is 5.57 acre feet per acre per annum. The diversion requirement from Mill Creek to serve these lands is 206 acre feet per annum. Tr. 5244, Wyoming Exhibit WRIR HS-3.

175. In summary in the Little Wind Basin (See Findings 170-174) there are 836 acres of trust land with adjudicated water rights lying outside the boundaries of an irrigation project.

The annual diversion requirement for these lands is 4,551 acre feet of water. Tr. 5244, Wyoming Exhibit WRIR HS-3.

176A. On the main stem of the Big Horn River there are 100 acres of trust land with adjudicated water rights lying outside the boundaries of an irrigation project. The average diversion requirement is 5.94 acre feet per acre per annum. The annual diversion requirement from the main stem of the Big Horn to serve these lands is 594 acre feet. Tr. 5244, Wyoming Exhibit WRIR HS-3.

177. On Cottonwood Creek, a tributary of the Big Horn, there are 505 trust acres with adjudicated water rights outside the boundaries of an irrigation project. The average annual diversion requirement is 5.89 acre feet per acre. The total annual diversion requirement from Cottonwood Creek to serve these lands is 2,974 acre feet. Tr. 5245, Wyoming Exhibit WRIR HS-3.

178. On Muddy Creek, a tributary of the Big Horn, there are 2,901 acres of trust land having adjudicated water rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.43 acre feet per acre per annum. The annual diversion requirement from Muddy Creek to serve these lands is 15,752 acre feet of water. Tr. 5245, Wyoming Exhibit WRIR HS-3.

179. On Five Mile Creek, a tributary of the Big Horn, there are 156 acres of trust land with adjudicated water rights lying outside the boundary of an irrigation project. The average diversion requirement for these lands is 5.57 acre feet per acre per annum. The annual diversion requirement from Five Mile Creek to serve these lands is 869 acre feet of water. Tr. 5245, Wyoming Exhibit WRIR HS-3.

180. In sum (see Findings 176A - 179), there are 3,662 acres of trust land with adjudicated water rights within the Big Horn Basin and lying outside the boundaries of an irrigation project. The diversion requirement for these lands is 20,189 acre feet per year. Tr. 5245, Wyoming Exhibit WRIR HS-3.

181. There are 320 acres of trust land with adjudicated water rights on the North Fork of the Popo Agie lying outside the boundaries of an irrigation project. The average diversion requirement for these lands is 5.40 acre feet per acre per annum. The diversion requirement from the North Fork of the Popo Agie to serve these lands is 1,728 acre feet of water per year. Tr. 5245,[12/] Wyoming Exhibit WRIR HS-3.

12/ The transcript erroneously says the annual diversion requirement is 1,728 acre feet.

182. On the main stem of the Popo Agie there are 40 acres of trust land with adjudicated water rights lying outside the boundaries of an irrigation project. The average diversion requirement is 5.4 acre feet per acre per annum. The diversion requirement from the main stem of the Popo Agie is 216 acre feet per year. Tr. 5245, Wyoming Exhibit WRIR HS-3.

183. In sum (see Findings 181 - 182), there are 360 acres of trust land on the Popo Agie which have adjudicated water rights but are outside the boundaries of an irrigation project. The annual diversion requirement for these lands is 1,944 acre feet. Tr. 5245, Wyoming Exhibit WRIR HS-3.

184. On the South Fork of Owl Creek, there are 1,620 acres of trust land with adjudicated water rights but outside the boundaries of an irrigation project. The average diversion requirement is 5.46 acre feet per acre per annum. The annual diversion requirement from the South Fork of Owl Creek is 8,845 acre feet of water. Tr. 5246, Wyoming Exhibit WRIR HS-3.

185. On the main stem of Owl Creek there are 2,265 acres of trust land having adjudicated water rights but lying outside the boundaries of an irrigation project. The average diversion requirement for these lands is 5.4 acre feet per acre per annum. The annual diversion requirement from the main stem of Owl Creek to serve these lands is 12,231 acre feet. Tr. 5246, Wyoming Exhibit WRIR HS-3.

186. On Mud Creek there are 754 acres of trust land with adjudicated water rights but lying outside the boundaries of an irrigation project. The average diversion requirement is 5.43 acre feet per acre per annum. The annual diversion requirement from Mud Creek to serve these lands is 4,094 feet. Tr. 5246, Wyoming Exhibit WRIR HS-3.

187. In sum in the Owl Creek Basin (see Findings 184-186) there are 4,639 acres of trust land lying outside the boundaries of an irrigation project and the annual diversion requirement to serve these lands is 25,170 acre feet of water.

188. In total there are 16,241 acres of trust land with adjudicated water rights lying outside the boundaries of an irrigation project. The annual diversion requirement to serve these lands is 87,947 acre feet of water. Tr. 5246. (Findings 162-187.)

189. In sum (see Findings 147 and 188), there are a total of 17,411 acres of trust land on the reservation with adjudicated water rights. The annual diversion requirement for these lands is 97,404 acre feet of water. Tr. 5247, Wyoming Exhibit WRIR HSO-3.

190. On the East Fork of the Wind River there are 10 acres of trust land currently receiving water without an adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.06 acre feet per acre per annum. The annual diversion

requirement from the East Fork of the Wind River to serve these lands is 51 acre feet of water. Tr. 5248, Wyoming Exhibit WRIR HS-5.

191. On Dinwoody Creek there are 154 acres of trust land currently receiving water without an adjudicated water right and outside the boundaries of an irrigation project. The average diversion requirement is 5.57 acre feet per acre per annum. The annual diversion requirement from Dinwoody Creek to serve these lands is 858 acre feet of water. Tr. 5248, Wyoming Exhibit WRIR HS-5.

192. On Dry Creek there are 183 acres of trust land currently receiving water without an adjudicated water right and outside the boundaries of an irrigation projects. The average diversion requirement is 5.54 acre feet per annum. The annual diversion requirement from Dry Creek to serve these lands is 1,014 acre feet of water. Tr. 5248, Wyoming Exhibit WRIR HS-5.

193. There are 26 acres of trust land on Bull Lake Creek which are currently receiving water but have no adjudicated water right and lie without the boundaries of an irrigation project. The average diversion requirement for these lands is 5.4 acre feet of water per acre per annum. The annual diversion requirement from Bull Creek to serve these lands is 140 acre feet of water. Tr. 5248, Wyoming Exhibit WRIR HS-5.

194. On Meadow Creek there are 179 acres of trust land currently receiving water but having no adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.51 acre feet per acre per annum. The annual diversion requirement from Meadow Creek to serve these lands is 986 acre feet of water. Tr. 5248, Wyoming Exhibit WRIR HS-5.

195. On Dry Pasup Creek there are 56 acres of trust land currently receiving water but having no adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement for these lands is 5.2 acre feet per acre. The annual diversion requirement from Dry Pasup Creek to serve these lands is 291 acre feet of water. Tr. 5248, Wyoming Exhibit WRIR HS-5.

196. On Crow Creek there are 36 acres of trust land currently receiving water but having no adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.4 acre feet per acre per annum. The annual diversion requirement from Crow Creek to serve these lands is 194 acre feet of water. Tr. 5248, Wyoming Exhibit WRIR HS-5.

197. On Willow Creek there are 7 acres of trust land currently receiving water without an adjudicated water right and lying outside the boundaries of an irrigation project.

The average annual diversion requirement is 5.06 acre feet per acre per annum. The annual diversion requirement from Willow Creek to serve these lands is 35 acre feet of water. Tr. 5249, Wyoming Exhibit WRIR HS-5.

198. On the main stem of the Wind River there are 487 acres of trust land currently receiving water and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.77 acre feet per acre per annum. The annual diversion requirement from the main stem of the Wind River to serve these lands is 2,810 acre feet of water. Tr. 5249, Wyoming Exhibit WRIR HS-5.

199. In sum (see Findings 190 - 198), in the Wind River Basin there are 1,138 acres of trust land currently receiving water without an adjudicated water right and lying outside the boundaries of an irrigation project. The annual diversion requirement for these lands is 6,379 acre feet of water. Tr. 5249, Wyoming Exhibit WRIR HS-5.

200. On the North Fork of the Little Wind there are 1,776 acres of trust land currently receiving water without an adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.14 acre feet per acre per annum. The annual diversion requirement from the North Fork of the Little Wind for these lands is 9,129 acre feet of water. Tr. 5249, Wyoming Exhibit WRIR HS-5.

201. There are 781 acres of trust land on the South Fork of the Little Wind currently receiving water but without an adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.11 acre feet per acre per annum. The annual diversion requirement from the South Fork of the Little Wind for these lands is 3,991 acre feet of water. Tr. 5249, Wyoming Exhibit WRIR HS-5.

202. On the main stem of the Little Wind River there are 386 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.94 acre feet per acre per annum. The annual diversion requirement from the main stem of the Little Wind for these lands is 2,293 acre feet of water. Tr. 5249, Wyoming Exhibit WRIR HS-5.

203. On Sage Creek there are 776 acres of trust land currently receiving water without an adjudicated water right and lying outside the boundaries of an irrigation district. The average diversion requirement is 5.51 acre feet per acre per annum. The annual diversion requirement from Sage Creek to serve these lands is 4,276 acre feet of water. Tr. 5249, Wyoming Exhibit WRIR HS-5.

204. On Crooked Creek there are 69 acres of trust land currently receiving water but without an adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.26 acre feet per acre per annum. The annual diversion requirement from Crooked Creek to serve these lands is 363 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

205. On Trout Creek there are 228 acres of trust land currently receiving water but having no adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.46 acre feet per acre per annum. The annual diversion requirement to serve these lands from Trout Creek is 1,245 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

206. On Spring Creek there are 178 acres of trust land currently receiving water but having no adjudicated water right and lying outside the boundaries of an irrigation project. The average annual diversion requirement is 4.97 acre feet per acre per annum. The annual diversion requirement to serve these lands from Spring Creek is 885 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

207. On Big Horn Draw there are 139 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 4.94 acre feet per acre per annum. The annual diversion requirement from Big Horn Draw to irrigate these lands is 687 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

208. In sum (see Findings 200 - 207), there are 4,333 acres of trust land in the Little Wind Basin that currently receive water but have no adjudicated water rights and are outside the boundaries of an irrigation project. The annual diversion requirement for these lands is 22,869 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

209. On the main stem of the Big Horn River there are 2 acres of trust land currently receiving water but having no adjudicated rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.94 acre feet per acre per annum. The annual diversion requirement from the main stem of the Big Horn to serve these lands is 12 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

210. On Cottonwood Creek there are 320 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation

project. The average diversion requirement is 5.89 acre feet per acre per annum. The annual diversion requirement from Cottonwood Creek to serve these lands is 1,885 acre of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

211. On Muddy Creek there are 1,194 acres of trust land currently receiving water but having no adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.6 acre feet per acre per annum. The annual diversion requirement to serve these lands from Muddy Creek is 6,686 acre feet. Tr. 5250, Wyoming Exhibit WRIR HS-5.

212. On Five Mile Creek there are 362 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.57 acre feet per acre per annum. The annual diversion requirement to serve these lands from Five Mile Creek is 2,016 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

213. In sum (see Findings 209 - 212), in the Big Horn River Basin there are a total of 1,878 acres of trust land currently receiving water but not having an adjudicated water right and lying outside the boundaries of an irrigation project. The annual diversion requirement from the Big Horn Basin to serve these lands is 10,599 acre feet of water. Tr. 5250, Wyoming Exhibit WRIR HS-5.

214. On the North Fork of the Popo Agie there are 112 acres of trust land currently receiving water but having no adjudicated water right and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.43 acre feet per acre per annum. The annual diversion requirement to serve these lands from the North Fork of the Popo Agie is 608 acre feet of water. Tr. 5251, Wyoming Exhibit WRIR HS-5.

215. On the main stem of the Popo Agie there are 74 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.74 acre feet per acre per annum. The annual diversion requirement to serve these lands from the main stem of the Popo Agie is 425 acre feet of water. Tr. 5251, Wyoming Exhibit WRIR HS-5.

216. In sum (see Findings 214 - 215), on the Popo Agie basin there are 186 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The annual diversion requirement to serve these lands from the Popo Agie basin is 1,033 feet of water. Tr. 5251, Wyoming Exhibit WRIR HS-5.

217. On the South Fork of Owl Creek, there are 84 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.51 acre feet per acre per annum. The annual diversion requirement from the South Fork of Owl Creek to serve these lands is 463 acre feet of water. Tr. 5251, Wyoming Exhibit WRIR HS-5.

218. On the main stem of Owl Creek there are 46 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The average annual diversion requirement is 5.4 acre feet per acre per annum. The annual diversion requirement from the main stem of Owl Creek to serve these lands is 248 acre feet of water. Tr. 5251, Wyoming Exhibit WRIR HS-5.

219. On Mud Creek there are 185 acres of trust land currently receiving water but having no adjudicated water rights and lying outside the boundaries of an irrigation project. The average diversion requirement is 5.29 acre feet per acre per annum. The annual diversion requirement from Mud Creek is to serve these lands is 979 acre feet of water. Tr. 5251, Wyoming Exhibit WRIR HS-5.

220. In sum (see Findings 217-219), there are 315 acres of trust land in the Owl Creek Basin currently receiving water without an adjudicated water right and lying outside the boundaries of an irrigation project. The annual diversion requirement from the basin for these lands is 1,690 acre feet of water.

221. As shown in Findings 200 through 220 above, there are 7,850 acres of trust lands currently receiving water but not having adjudicated water rights and lying outside the boundaries of an irrigation project. The annual diversion requirement for these lands is 42,570 acre feet of water. Tr. 5251

222. There are a total of 34,427 acres of trust land lying within and without irrigation projects, currently receiving water but having no adjudicated water rights. The annual diversion requirement for these lands is 222,915 acre feet of water. Tr. 5252, Wyoming Exhibit WRIR HS-5. (See Findings 199 and 221.)

223. "Type VII" lands are trust lands which have a history of irrigation but are not being irrigated currently. Tr. 5254. As used in this section "Type VII lands have no adjudicated water rights.

224. Stetson Engineers examined aerial photos and topographic maps of the areas in which each arable Type VII parcel, as identified by Ross Waples of H.K.M., is located. In addition

Mr. Stetson visited each Type VII parcel by helicopter to analyze them from the standpoint of water requirements and the costs necessary to put the lands into full irrigation. Tr. 5255-56.

225. The items examined by Stetson to determine costs to restore Type VII lands to full irrigation included costs of repair or replacement of headworks, diversion structures, canal extension or enlargements, head ditches on the farm units, pump costs, annual energy costs to operate the pumps and operation and maintenance costs on a parcel by parcel basis. Tr. 5256.

226. The costs were developed on a per acre basis for a particular parcel for which the costs would be incurred. Tr. 5257.

227. Of the 10,440 acres of Type VII trust land found to be arable by the United States soils scientist, only 7,941 acres were determined to be irrigable by Mr. Stetson based on consultation with Mr. Dornbush. Tr. 5258.

228. "Irrigable" Type VII lands are found both within and without the Wind River Irrigation Project. Tr. 5258.

229. The diversion requirements for the Type VII lands lying within an irrigation project are determined on a per acre basis in the same manner as the diversion requirements for the other trust lands lying within the projects, i.e., on the basis of the historic diversion records of a project divided by the total acreage served by that project. Tr. 5258.

230. Within the Ray Unit of the Wind River Irrigation Project there are 1,769 acres of irrigable Type VII trust land. The average diversion requirement for the Ray Unit is 5.32 acre feet per acre per annum. The annual diversion requirement for the Type VII irrigable trust lands in the Ray Unit is 9,411 acre feet of water.* Tr. 5258-59, Wyoming Exhibit WRIR HS-4.

231. In the Coolidge Unit of the Wind River Irrigation Project there are 1,161 acres of Type VII irrigable trust lands. The average diversion requirement for the Coolidge Unit is 4.95 acre feet per acre per annum. The annual diversion requirement for the Type VII irrigable trust lands in the Ray Unit is 5,747 acre feet of water. Tr. 5260, Wyoming Exhibit WRIR HS-4.

232. In the Subagency Unit of the Wind River Irrigation Project there are 200 acres of irrigable Type VII trust land. The average diversion requirement for the Subagency Unit is 5.26 acre feet per acre per annum. The annual diversion requirement for the irrigable Type VII trust lands within the Subagency Unit is 1,052 acre feet of water. Tr. 5260, Wyoming Exhibit WRIR HS-4.

233. In the Upper Wind Unit there are 99 acres of irrigable Type VII trust land on the Wind River "A" canal. The average diversion requirement for the Upper Wind Unit is 12.06 acre feet per acre per annum. Thus the annual diversion

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* Wherever an asterisk appears it indicates that the acreage and annual diversion requirement reflect changes made in Mr. Stetson's acreage totals by Mr. Dornbusch, in subsequent testimony. Tr. 5759. United States Exhibit WRIR C-278.

requirement for the irrigable Type VII trust lands served by Wind River "A" canal is 1,194 acre feet per acre per year. Tr. 5260, Wyoming Exhibit WRIR HS-4.

234. In the Upper Wind Unit in the Dinwoody Bench area there are 393 irrigable Type VII trust acres. The average diversion requirement for the Upper Wind Unit is 12.06 acre feet per acre per annum. Thus the annual diversion requirement for the irrigable Type VII trust lands along Dinwoody Bench is 4,738 acre feet of water. Tr. 5260, Wyoming Exhibit WRIR HS-4.

235. In the Johnstown Unit there are 189 irrigable acres of Type VII trust land. The average diversion requirement for the Johnstown Unit is 6.94 acre feet per acre per annum. The annual diversion requirement for the irrigable Type VII trust acres therefore is 1,312 acre feet. Tr. 5260, Wyoming Exhibit WRIR HS-4.

236. In the Lefthand Unit there are 587 acres of irrigable Type VII trust land. The average diversion requirement for the Lefthand Unit is 6.9 acre feet per acre per annum. The annual diversion requirement for the irrigable Type VII trust land in the Lefthand Unit is therefore 4,050 acre feet of water. Tr. 5260, Wyoming Exhibit WRIR HS-4.

237. In the LeClair Irrigation District there are 100 acres of irrigable Type VII trust land. The average diversion requirement for the LeClair Irrigation District is 5.48 acre feet per acre per annum. Thus, the annual diversion

requirement for the irrigable Type VII trust lands in the LeClair District is 548 acre feet per year. Tr. 5260, Wyoming Exhibit WRIR HS-4.

238. In sum (see Findings 230 - 237), within the irrigation project area there are 4,498 acres of irrigable Type VII trust land having an annual diversion requirement of 28,052 acre feet of water. Tr. 5260, Wyoming Exhibit WRIR HS-4. As modified at Tr. 5432.

239. On the East Fork of the Wind River there are 41 acres of irrigable Type VII trust land outside of an irrigation project. The average diversion requirement for lands served by the East Fork is 5.06 acre feet per acre per annum. Therefore the annual diversion requirement for the irrigable Type VII trust lands on the East Fork is 207 acre feet of water. Tr. 5261, Wyoming Exhibit WRIR HS-4.

240. On Dry Creek there are 4 acres of irrigable Type VII trust land not within an irrigation project. The average diversion requirement for lands served by Dry Creek is 5.57 acre feet per acre per annum. The annual diversion requirement for the irrigable Type VII trust lands on Dry Creek is 22 acre feet of water. Tr. 5261, Wyoming Exhibit WRIR HS-4.

241. On Bull Lake Creek there are 37 acres of irrigable Type VII trust land not within an irrigation project. The average annual diversion requirement for lands served by Bull Lake Creek is 5.37 acre feet per acre per year. The annual diversion requirement for the irrigable Type VII trust lands on Bull Lake Creek therefore is 199 acre feet of water. Tr. 5261, Wyoming Exhibit WRIR HS-4.

242. On Meadow Creek there are 160 acres of irrigable Type VII trust lands not within an irrigation project. The average diversion requirement for the lands irrigated by Meadow Creek is 5.09 acre feet per acre per annum. The annual diversion requirement for the irrigable Type VII trust lands on Meadow Creek therefore is 814 acre feet of water. Tr. 5261, Wyoming Exhibit WRIR HS-4.*

243. On Dry Pasup Creek there are 115 irrigable acres of Type VII trust land not within an irrigation project. The average diversion requirement for lands irrigated by Dry Pasup Creek is 5.06 acre feet per acre. The annual diversion requirement for the irrigable Type VII trust land on Dry Pasup Creek therefore is 581 acre feet of water. Tr. 5261, Wyoming Exhibit WRIR HS-4.*

244. On Crow Creek there are 154 irrigable acres of Type VII trust land not within an irrigation project. The average diversion requirement for lands irrigated by Crow

Creek is 5.29 acre feet per acre. The annual diversion requirement for the Type VII irrigable trust lands therefore is 815 acre feet per acre. Tr. 5261, Wyoming Exhibit WRIR HS-4.*

245. On the main stem of the Wind River there are 213 acres of irrigable Type VII trust land, not within an existing irrigation project. The average diversion requirement for lands served by the main stem of the Wind River is 5.51 acre feet per acre per annum. The annual diversion requirement for the Type VII irrigable trust lands on the main stem of the Wind River therefore is 1,174 acre feet of water. Tr. 5261, Wyoming Exhibit WRIR HS-4.

246. In sum (see Findings 239 - 245), there are 724 acres of Type VII irrigable trust land in the Wind River Basin which are not within an irrigation project. The annual diversion requirement for these lands is 3,812 acre feet of water.

247. On the North Fork of the Little Wind there are 357 non-project irrigable acres of Type VII trust land. The average diversion requirement for lands irrigatd by the North Fork is 5.03 acre feet per acre per annum. The annual diversion requirement to serve the Type VII irrigable trust lands on the North Fork is therefore 1,795 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.*

248. On the South Fork of the Little Wind there are 44 acres of Type VII non-project trust land. The average diversion requirement for lands irrigated by the South Fork is 5.09 acre feet per acre per annum. The annual diversion requirement for the irrigable Type VII trust lands is therefore 224 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

249. On the main stem of the Little Wind there are 805 acres of non-project irrigable Type VII trust lands. The average diversion requirement of lands irrigated by the main stem of Little Wind is 5.94 acre feet per acre of water per annum. The annual diversion requirement for the non-project irrigable Type VII trust lands on the main stem of the Little Wind therefore is 4,782 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

250. On Mill Creek there are 10 irrigable acres of non-project Type VII trust lands. The average diversion requirement for lands irrigated by Mill Creek is 5.57 acre feet per acre per annum. The annual diversion requirement for the non-project Type VII irrigable trust lands on Mill Creek is therefore 56 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

251. On Sage Creek there are 822 irrigable acres of non-project Type VII lands. The average water duty for lands served by Sage Creek is 5.57 acre feet per acre per annum.

The annual diversion required to serve the non-project lands Type VII irrigable trust lands from Sage Creek therefore is 4,579 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

252. On Crooked Creek there are 3 irrigable acres of non-project Type VII trust lands. The average diversion requirement for lands irrigated by Crooked Creek is 5.57 acre feet per acre per annum. The annual diversion required to serve the non-project Type VII trust lands therefore is 17 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

253. On Trout Creek there are 63 irrigable acres of non-project Type VII trust land. The average diversion requirement for Trout Creek is 5.11 acre feet per acre per annum. The annual diversion required to serve the non-project Type VII trust lands on Trout Creek therefore is 322 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

254. In sum (see Findings 247-253), there are 2,104 irrigable acres of non-project Type VII trust lands within the Little Wind River Basin and the annual diversion requirement for these lands is 11,775 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

255. On the main stem of the Big Horn there are 24 irrigable acres of non-project Type VII trust lands. The average diversion requirement for lands irrigated by the main stem of the Big Horn is 5.94 acre feet per acre per annum.

The annual diversion required to serve the non-project Type VII irrigable trust land on the main stem of the Big Horn is 143 acre feet of water. Tr. 5262, Wyoming Exhibit WRIR HS-4.

256. On Cottonwood Creek there are 117 irrigable acres of non-project Type VII trust land. The average diversion requirement for lands irrigated from Cottonwood Creek is 5.89 acre feet per acre per annum. The annual diversion required to serve the non-project Type VII irrigable trust lands from Cottonwood Creek is 689 acre feet of water.

257. On Muddy Creek there are 186 irrigable acres of non-project Type VII trust land. The average diversion requirement for lands irrigated by Muddy Creek is 5.63 acre feet per acre per annum. The annual diversion required to irrigate the non-project Type VII irrigable trust lands on Muddy Creek therefore is 1,047 acre feet per acre. Tr. 5263, Wyoming Exhibit WRIR HS-4.

258. In sum (see Findings 255-257), in the Big Horn Basin there are 327 irrigable acres of Type VII trust land not lying within the boundaries of an irrigation project. The annual diversion required to serve these lands is 1,879 acre feet of water.

259. On the North Fork of the Popo Agie there are 102 irrigable acres of non-project Type VII trust land. The average diversion requirement for lands irrigated from the

North Fork is 5.4 acre feet per acre per annum. The annual diversion required from the North Fork of the Popo Agie to irrigate the non-project Type VII irrigable trust land is 551 acre feet of water. There are no additional irrigable acres of non-project Type VII trust land on the main stem of Popo Agie so the annual diversion requirement from the Popo Agie Basin is 551 acre feet of water. Tr. 5263, Wyoming Exhibit WRIR HS-4.

260. On the South Fork of Owl Creek there are 64 irrigable acres of non-project Type VII land. The average diversion requirement for land irrigated from the South Fork is 5.57 acre feet per acre per annum. The annual diversion requirement for non-project Type VII irrigable acres from the South Fork is 356 acre feet of water. Tr. 5263, Wyoming Exhibit WRIR HS-4.

261. On the main stem of Owl Creek there are 87 acres of irrigable non-project Type VII trust lands. The average diversion requirement for lands irrigated from the main stem is 5.37 acre feet per acre per annum. The annual diversion requirement from the main stem of Owl Creek for the non-project Type VII irrigable trust lands therefore is 467 acre feet of water. Wyoming Exhibit WRIR HS-4.

262. On Mud Creek there are 40 irrigable acres of non-project Type VII trust lands. The average diversion for lands irrigated from Mud Creek is 5.37 acre feet per acre per annum. The annual diversion requirement to serve the non-project irrigable Type VII trust lands from Mud Creek therefore is 215 acre feet of water. Tr. 5263-64,[13/] Wyoming Exhibit WRIR HS-4.

263. In sum (see Findings 260-226), in the Owl Creek Basin there are 191 irrigable acres of non-project Type VII trust lands which require a total annual diversion of 1,038 acre feet of water. Tr. 5264, Wyoming Exhibit WRIR HS-4.

264. The irrigable trust acres of Type VII lands, within and without irrigation project boundaries, total 7,946 acres and require a total annual diversion of 47,107 acre feet of water. Tr. 5264, Wyoming Exhibit WRIR HS-4. As modified at Tr. 5432.

265. The total acreage consisting of trust lands with adjudicated water rights, trust lands currently receiving water but having no adjudicated water rights, and irrigable Type VII lands, both within and without the boundaries of an irrigation project, is 59,784. The annual diversion required for these acres is 367,426 acre feet of water. Tr. 5265 as modified at Tr. 5432, et seq.

266. For the non-project adjudicated, unadjudicated in use, and Type VII trust lands in the Wind River basin the annual diversion requirement are: East Fork of the Wind River, 1,568 acre feet; Dinwoody Creek, 953 acre feet; Dry Creek 1,036 acre feet; Bull Lake Creek, 339 acre feet; Meadow Creek 2,701 acre feet; Dry (Pasup) Creek, 11,370 acre feet; Crow Creek, 16,551 acre feet; Willow Creek, 369 acre feet; the main stem of the Wind River, 11,397 acre feet.

267. For the non-project adjudicated, unadjudicated in use, and Type VII trust lands in the Little Wind Basin the annual diversion requirements are: from the North Fork, 13,587 acre feet; from the South Fork, 4,744 acre feet; from the main stem, 7,075 acre feet; from Sage Creek, 10,008 acre feet; from Crooked Creek, 380 acre feet; from Trout Creek, 1,567 acre feet; from Spring Creek, 885 acre feet; from Big Horn Draw 687 acre feet; from Mill Creek, 262 acre feet.

268. In the Big Horn River Basin, the annual diversion requirements for the non-project adjudicated, unadjudicated in use, and Type VII trust lands are: from the main stem of the Big Horn, 749 acre feet of water; from Cottonwood Creek, 5,548 acre feet of water; from Muddy Creek, 23,485 acre feet of water; from Five Mile Creek, 2,885 acre feet of water.

13/ The transcript reads that the annual diversion requirement is "251" acre feet. It should read "215".

269. For the non-project adjudicated, unadjudicated in use, and Type VII trust lands in the Popo Agie Basin, the diversion requirements are: from the North Fork of the Popo Agie, 2,887 acre feet per year; from the South Fork of the Popo Agie, 641 acre feet per year.

270. For the non-project adjudicated, unadjudicated in use, and Type VII trust lands in the Owl Creek basin, the diversion requirements are: from the South Fork of Owl Creek, 9,664 acre feet a year; from the main stem of Owl Creek, 12,946 acre feet a year;[14/] from Mud Creek, 5,288 acre feet a year;

271. In the Little Wind Unit of the Wind River Federal Irrigation Project, the diversion requirements for adjudicated, unadjudicated in use, and Type VII trust lands are: for the Ray Unit 52,657 acre feet per year; for the Coolidge Unit 38,753 acre feet per year; for the Subagency Unit 16,632 acre feet per year.

272. In the Upper Unit of the Wind River Irrigation Project, the diversion requirements for the adjudicated, unadjudicated in use, and Type VII trust lands are: from the Wind River "A" canal, 13,483 acre feet per year; from Dinwoody Bench, 66,281 acre feet per year.

14/ All but 434 of these acres served by the main stem of Owl Creek lie outside the stipulated boundaries of the reservation and the United States does not claim an 1868 priority date for the Owl Creek lands north of the boundary. See Article IV of the proposed decree.

273. For the Johnstown Unit of the Wind River Irrigation Project the diversion requirement for the adjudicated, unadjudicated in use, and Type VII trust lands is 4,539 acre feet per year.

274. For the Lefthand Unit of the Wind River Irrigation Project the diversion requirement for adjudicated, unadjudicated in use, and Type VII trust lands is 14,821 acre feet per year.

275. For the Midvale Irrigation Project, the annual diversion requirement for adjudicated, unadjudicated in use, and Type VII trust lands is 3,175 acre feet per year from the Wind River.

276. For the LeClair Irrigation District, the diversion requirement for adjudicated, unadjudicated in use, and Type VII trust land is 7,513 acre feet per year from the Wind River.

C. Type VIII And Owl Creek Unit

277. Dr. Mesghinna determined the water requirements, the investment costs and the operation and maintenance costs for the so-called "Type VIII" lands and the Owl Creek future project.

278 Type VIII lands are arable trust lands, lying within the boundaries of the Wind River Federal Irrigation Project that have not been previously irrigated. Such lands are found in the Upper Wind Unit, the Coolidge Unit, the Ray Unit, the Subagency Unit, and the Johnstown Unit. Tr. 5582. The streams and rivers that serve these units were identified by Mr. Stetson. See Findings 136-137. The Type VIII lands were identified and their arability determined by H.K.M. Associates and through the testimony of Ross Waples.

279. The Owl Creek Unit does not lie within the boundaries of a federal irrigation project. It was identified as "future" project land and its arability were determined by H.K.M. Associates and through the testimony of Mr. Kersich. Dr. Mesghinna sometimes referred to it as "Arapahoe Ranch." Tr. 5582.

280. In order to determine the water requirements and costs of irrigating the Type VIII lands and the Owl Creek Unit, Dr. Mesghinna employed the same methodology that he used in determining the water requirements and the costs of the future project units described in Findings 105-128, infra. Since the Type VIII lands are within the boundaries of existing irrigation projects, no costs for canals or related structures needed to be estimated. Tr. 5583-84.

281. Dr. Mesghinna's designs are limited to lands that had been classified as either class 1, class 2, or class 3 lands by Mr. Kersich and H.K.M. Associates. Tr. 5588-89, United States Exhibit WRIR C-43, pp. 8-9.

282. The cost estimates developed by Dr. Mesghinna to bring each parcel into production were provided by him to Mr. Dornbusch. Mr. Dornbusch, upon his review of these estimates, advised Dr. Mesghinna as to which parcels would provide an economic return sufficient to justify the costs. Tr. 5605.

283. The water requirements for the Type VIII lands and the Owl Creek Unit were, like the water duties for the future project units, determined on the basis of "net acres". That is they were determined on the basis of the acreage remaining after Dr. Mesghinna excluded those acres that could not be feasibly irrigated from a strictly engineering standpoint and those acres that could be irrigated from an engineering standpoint but which could not be economically irrigated according to Mr. Dornbusch, and after Dr. Mesghinna excluded 5 percent of the remaining total for farmsteads and other man made structures. Tr. 5604.

284. The parties have stipulated that all of the Type VIII lands for which Dr. Mesghinna determined water duties and costs and all of the Owl Creek Unit lands are within the reservation boundaries and are held in trust by the United States for the Tribes or individual Indians. None of the lands are reacquired lands. Tr. 5595-97.

285. In the Upper Wind Unit there are 492 net acres of Type VIII irrigable trust land with an annual diversion requirement of 2056 acre feet of water. Tr. 5599.

286. In the Coolidge Unit there are 200 net acres of Type VIII irrigable trust land with an annual diversion requirement of 1001 acre feet of water. Tr. 5599

287. In the Ray Unit there are 28 net acres of Type VIII irrigable lands with an annual diversion requirement of 118 acre feet of water. Tr. 5599.

288. In the Subagency Unit there are 306 net acres of Type VIII irrigable trust land with an annual diversion requirement of 1,531 acre feet of water. Tr. 5599

289. In the Johnstown Unit there are 190 net acres of Type VIII irrigable trust land with an annual diversion requirement 951 acre feet of water. Water for these lands would be diverted from the Wind River through the Johnstown Canal. Tr. 5599.

290. In the Owl Creek Unit future project, there are 245 net acres of irrigable land. The annual diversion requirement is 855 acre feet of water. Water to serve these lands would be diverted from the South Fork of Owl Creek. Tr. 5599.

291. In total there are 1461 net acres of irrigable trust lands of the Type VIII category or in the proposed Owl Creek Unit. The annual diversion requirement for these lands is 6,512 acre feet of water.

V. AGRICULTURAL ECONOMICS REGARDING THE FUTURE PROJECTS, TYPES VII AND VIII AND THE UNADJUDICATED IN USE LANDS

A. Future Lands

292. An economic feasibility analysis was conducted by David Dornbusch, a consultant economist experienced in economic feasibility analysis. United States Exhibit WRIR C-266. This economic feasibility analysis was conducted on the proposed irrigation and drainage systems that Dr. Woldezion Mesghinna designed and costed for the North Crowheart, South Crowheart, Big Horn Flats, Arapahoe and Riverton East units. (See Findings 95 through 134). Tr. 4890-5139, 5717-6277, United States Exhibits WRIR C-267-WRIR C-268.

293. Important factors in the economic analysis were crop selection, yields attainable from those crops, prices obtained for those crops, cost of crop production, and on-farm irrigation costs. All of these factors combine to determine the net benefits for each proposed project area. Net benefits were then divided by the irrigation system cost determined by Dr. Mesghinna to derive a benefit-cost ratio for each proposed project area. United States Exhibit WRIR C-267, WRIR C-268.

294. The crop selection and mix chosen by Mr. Dornbusch of 5 percent malting barley, 16 percent nurse malt barley, 67 percent alfalfa, 5 percent corn silage and 7 percent corn grain for the lowland area below 5900 ft. was a reasonable selection. The crop mix and selection used by Mr. Dornbusch for the highland

area above 5900 ft. of 17 percent malting barley, 16 percent nurse malt barley, and 67 percent alfalfa was also reasonable. The crop mixes and selections were based on reliable sources including a report prepared by an extension farm management specialist, interviews with area farmers and other knowlegable people from the area such as other agricultural extension agents. United States Exhibit WRIR C-268, table 3, p. 11, Tr. 4942, Wyoming Exhibits ED-16 and ED-8.

295. Mr. Dornbusch reduced the obtainable yields for all crops grown above 5900 Ft. elevation due to the possibility of a shorter growing season. This elevation breakpoint was reasonable and conservative in view of the fact that the results of the farmer interviews conducted by Mr. Dornbusch above 5900 ft. showed no reduction in yields due to growing season. Tr. 4946-50.

296. In determining the gross returns per acre Mr. Dornbusch used reasonable yields attainable in the area for the crops he had selected in the lowlands of 100 bushels per acre for malt barley, 88 bushels per acre for nurse barley, .75 tons per acre for baled straw from the malt and nurse barley, 4.5 tons per acre for alfalfa, 1.5 AUM's per acre for alfalfa aftermath, 20 tons per acre for corn silage, 89 bushels per acre for corn grain and 1.6 AUM's for corn grain aftermath. His yields for the highland areas of 90 bushels per acre of malt barley, 79 bushels per acre of nurse barley, .75 tons per acre of baled straw for malt and nurse barley, 4.1 tons per acre of alfalfa, and 1.5 AUM's per

acre of alfalfa aftermath was reasonable. United States Exhibit WRIR C-268.

297. The yields used by Mr. Dornbusch for the lowland areas were the same except for barley yields as those reported by Wyoming's witness, Doug Agee, in his study "Cost of Producing Crops, Riverton Area, Fremont County, June 1977, Bulletin 619-R", Wyoming Exhibit ED-8. Tr. 4953, United States Exhibit WRIR C-268, p. 4.

298. Mr. Dornbusch's use of higher barley yields than those reported in Wyoming Exhibit ED-8 was justified and substantiated by farmer interviews that were conducted in the area by both the United States and State of Wyoming consultants. Tr. 4953, 14925-40, 15413, 11973-75, 11979-80, Wyoming Exhibit ED-16, United States Exhibits WRIR-JJ-7, WRIR-JJ-8, WRIR-JJ-9, WRIR-JJ-10. The increased barley yields were further justified by and are reasonable in view of the fact that Mr. Dornbusch increased his management costs and fertilizer application and costs over and above that used by Doug Agee in his Riverton Area Report, Wyoming Exhibit ED-8. Tr. 4975, 4991.

299. The ten percent yield reduction for crops grown in the highland area above 5900 feet used by Mr. Dornbusch was reasonable. Tr. 4948-49.

300. The 1979 normalized crop prices used by Mr. Dornbusch in his analysis were reasonable. United States Exhibit WRIR C-278, p. 4. There was no major dispute between the parties regarding crop prices, each being within a few cents of each other

with the exception of barley prices where Jim Jacobs, Wyoming's economist, used barley prices that were 20 percent higher than those used by Mr. Dornbusch. Tr. 14726-27, Wyoming Exhibit EJ-3 and EJ-4, Tr. 4959-65.

301. The annual gross returns found by Mr. Dornbusch for the lowland area of $271 per acre for malt barley, $26.50 per acre for baled barley straw, $238.48 per acre for nurse barley, $238.46 per acre for alfalfa, $8.22 per acre for alfalfa aftermath, $318 per acre for corn silage, $226.95 per acre for corn grain and $8.77 per acre for corn grain aftermath were reasonable. United States Exhibit WRIR C-268, p. 4.

302. The annual gross returns found by Mr. Dornbusch for the highland area of $243.90 per acre for malt barley, $26.50 per acre for baled barley straw, $214.09 per acre for nurse barley, $217.26 per acre for alfalfa, and $8.22 per acre for alfalfa aftermath were reasonable. United States Exhibit WRIR C-268, p. 4.

303. A key point in determining production costs is the determination of farm labor costs. Both the United States and the State of Wyoming agreed on the principle of using zero opportunity cost for some portion of the farm labor that would come from the large amount of unemployed Indians on the Wind River Indian Reservation. Mr. Dornbusch did an investigation that found historically high levels of unemployment on the reservation, that documented the younger Indians' willingness to work and that found a lack of future prospects of employment on or near the reservation,

apart from the projects proposed in this litigation, and that Wyoming did not conduct such a study. In view of of the above and the fact that the Indians' desire to remain on the reservation, it was reasonable for Mr. Dornbusch to cost 80 percent of the farm labor at zero opportunity cost and 20 percent at full opportunity cost and to phase in Indian management over a ten-year period, costing management labor accordingly. Furthermore, this was reasonable in light of the fact that there is sustained unemployment on the reservation far in excess of the numbers required to fill the labor positions required. Tr. 4985-89, 5907-14, 5925-26, 5934-43, 14831-32, 15009, Wyoming Exhibit ED-52.

304. A critical factor in determining production costs is farm machinery and equipment prices. Both the United States and the State of Wyoming agreed on the particular items of equipment to be used, but disagreed regarding the prices for that machinery and equipment. The equipment prices determined by Mr. Dornbusch which were those developed by Wyoming witness Doug Agee in Wyoming Exhibit ED-8 and normalized to 1979, were reasonable. The equipment prices used by Wyoming witness Jim Jacobs were unreasonable in view of the fact that they were considerably higher than any tractors and equipment prices found in the National Farm Tractor and Implement Blue Book. Tr. 14883-90, United States Exhibit JJ-4. Mr. Jacobs used Mr. Agee's prices only when he could not find higher USDA prices. United States Exhibit JJ-5; Tr. 14891-00, 15376-79.

305. A critically important factor in determining production costs is the per acre cost of farm equipment and machinery. Key points in determining per acre cost are the farm size for which a complete complement of equipment will be used and equipment efficiency. The United States and the State of Wyoming disagreed on both issues. Tr. 4979-81, 14866, 15014-17.

306. In view of the fact that the Indians on the Wind River Reservation are not limited to 160-acre farm sizes, Mr. Dornbusch's use of a tribal enterprise or co-op arrangement for the efficient use of farm equipment was prudent and reasonable. Government publications and Wyoming's witness Doug Agee verified that farm equipment could be utilized more efficiently and at a lower per acre cost on larger farms than assumed by Mr. Jacobs for the State of Wyoming. United States Exhibit WRIR DA-1, United States Exhibit WRIR CF-3, p. 7, Tr. 14866, 15014-17, 15334, 15380-88.

307. Mr. Jacobs' use of approximately 160 small farms of 320 acres each was unreasonable under the circumstances and resulted in adding unreasonable cost burden to his analysis. Tr. 14840-47, 14878-82.

308. The production costs used by Mr. Dornbusch are reasonable. These are $142.73 per acre for malt barley, $146.53 per acre for nurse barley, $77.30 per acre for alfalfa, $172.04 per acre for corn silage and $148.93 per acre for corn grain. United States Exhibit WRIR C-268, p. 5.

309. Net returns are determined by subtracting the production costs from the gross returns for both highland and lowland areas. Mr. Dornbusch's net return determination of $154.77 per acre for malt barley, $118.45 per acre for nurse barley, $169.38 per acre for alfalfa, $145.96 per acre for corn silage, and $86.79 per acre for corn grain in the lowland areas was reasonable. His net return determination of $127.67 per acre for malt barley, $94.06 per acre for nurse barley, and $148.18 per acre for alfalfa in the highland areas was reasonable. United States Exhibit WRIR C-268, p. 5.

310. The weighted average net returns were computed using the net returns and the crop percent distribution. Mr. Dornbusch's determination of $153.55 per acre for the lowland areas and $136.03 per acre for the highland areas was reasonable. United States Exhibit WRIR C-268, p. 11.

311. Both Mr. Dornbusch and Mr. Jacobs projected the costs and returns from the proposed projects over a 100 year span. Each then brought the 100 year stream of production costs and benefits back to a single present value to compare to the project development costs. Each economist used the technique of discounting to accomplish this. The United States, the Tribes and the State of Wyoming agreed that the discount rate that should be used is a "real" rate, that is, one that is net of expected inflation. This was the appropriate rate to use since all parties projected costs and returns net of inflation. The State of Wyoming disagreed with

the United States and the Tribes regarding the actual discount rate to be applied. Tr. 4992, 5002-03, 5008-03, 5021, 5036-42, 5078-82, 14521-22.

312. Four economists testified regarding the appropriate discount rate. The Tribes' economist, Mr. Ron Cummings, testified that discounting was inappropriate in this situation, but if it was to be applied then an appropriate range for the rate is between 2 and 4 percent. Tribes Exhibit 24, Tr. 8877-78. Mr. Dornbusch testified that the applicable rate was between 2 and 4 percent. Tr. 5049. Mr. Stephen Goldfeld, an economist with impeccable credentials regarding the discount rate, testified that in his opinion the rate was between 1 and 4 percent and if he were to choose one figure, he would use 2.5 percent. Tr. 15517-18. The State of Wyoming's economist, Mr. David Brookshire, testified that the appropriate rate was between 4 and 11 percent. Wyoming Exhibit EB-3, Tr. 14525-27.

313. In determining the appropriate discount rate the relevant considerations are the opportunity cost of capital displaced from investment and consumption in the long term and social time preference. Tr. 15492-94.

314. The appropriate discount rate to apply in an economic feasibility analysis for proposed agricultural development on the Wind River Indian Reservation is in the range of 1 to 4 percent. Tr. 15517, 5049, Tribes Exhibit 24, p. A.26.

315. Mr. Brookshire's use of a high and wide range of discount rates is unreasonable because he did not correctly interpret the Fraumeni and Jorgensen article regarding rates of return (Tribes' Exhibit DB-1), and because he did not consider marginal rates of return, opportunity cost of consumption or social time preference. Tr. 15490-27.

316. Mr. Dornbusch determined a single present value for the 100 year stream of annual benefits for each project area using a 4 percent discount rate. His net benefit present value determinations of $3,633 per acre for North Crowheart, $3,689 per acre for South Crowheart, $3,671 per acre for Big Horn Flats, $3,691 per acre for Riverton East and $3,704 per acre for Arapahoe was reasonable. United States Exhibit WRIR C-268, pp. 12-13.

317. Mr. Dornbusch took Dr. Mesghinna's costs for pipe networks, pumps and pumping plants, canals and related structures, drainage, operation and maintenance, energy and demand costs from United States Exhibit WRIR C-245, determined 1979 normalized prices, and determined the expected life for each item over the term of the project. Mr. Dornbusch added to Dr. Mesghinna's costs, reasonable estimates for engineering and contingencies, fencing and land preparation, adjusted for unemployed labor when appropriate, then discounted the stream of costs using appropriate methods to determine a present value. Tr. 5012-24, 5031-33, 5024-31.

318. Mr. Dornbusch's present value determination for the total irrigation system costs of $2,474 per acre for North Crowheart, $2,682 per acre for South Crowheart, $3,416 per acre for Big Horn Flats, $2,945 per acre for Riverton East

and $2,426 per acre for Arapahoe was reasonable. United States Exhibit WRIR C-268, p. 13.

319. All parties determined the benefit cost ratios for the proposed projects by dividing the present value of the net returns by the present value of the costs. Based upon a review of the testimony and exhibits the following benefit cost ratios are reasonable: North Crowheart 1.47, South Crowheart 1.29, Big Horn Flats 1.07, Riverton East 1.25, and Arapahoe 1.53.

320. Mr. Dornbusch has made a reasonable determination that the following acreages in the designated areas are economically feasible to develop and irrigate.

North Crowheart	38,773 Acres
South Crowheart	4,695 Acres
Big Horn Flats	2,670 Acres
Riverton East	3,814 Acres
Arapahoe	3,808 Acres
TOTAL	53,760 Acres

These are the same acreages that Dr. Mesghinna designed irrigation systems, drainage and water requirements for in United States Exhibit WRIR C-245, p. 42.

B. Historic Lands
Type VII, Type VIII and
Unadjudicated in Use

321. An economic feasibility analysis was conducted by David Dornbusch on the Type VII and VIII lands. United States Exhibit WRIR C-278, Tr. 5716-6277.

322. Mr. Dornbusch's analysis was conducted on those Type VII and VIII lands determined to be arable by Ross Waples and for which irrigation systems, drainage, or improvements were designed and costed by Dr. Mesghinna and Mr. Stetson. United States Exhibits WRIR C-226, WRIR C-277, Wyoming Exhibit HS-14B, Tr. 5720-55. (See Findings 95-291.)

323. Mr. Dornbusch's analysis for the Type VIII lands was conducted in the same manner as was the analysis for the future project lands. Benefit cost ratios were determined on a project basis for the Coolidge, Johnstown, Upper Wind, Subagency, and Ray units of the federal irrigation projects and for the Arapahoe Ranch area. Tr. 5721-22. (See Findings 293.)

324. Mr. Dornbusch used the same crop selection and mix, same crop yields, same crop price per unit and the same gross returns per acre in the Type VIII analysis as he did in the future project analysis. This was reasonable. Tr. 5721-22, United States Exhibits WRIR C-278, p. 2, WRIR C-268, p. 4. (See Findings 294 through 302.)

325. It was reasonable for Mr. Dornbusch to use the same 5,900 ft. elevation breakpoint for yield reduction due to growing season for the Type VIII analysis as he did for the future project analysis. Tr. 5728. (See Findings 295 and 299.)

326. It was reasonable for Mr. Dornbusch to make the same adjustment to farm labor costs in the Type VIII analysis as

he did in the future project analysis. This adjustment costed 80 percent of farm labor at zero opportunity cost and 20 percent of farm labor at full cost and costed management labor according to the same ten year phase-in period as in the future project analysis. Tr. 5724-25, 4985-89, 5907-14, 5925-26, 5934-43, Wyoming Exhibit ED-52.

327. It was reasonable and prudent for Mr. Dornbusch to increase his production costs on the Type VIII lands to account for a loss of efficiency in equipment operation due to the smaller size of parcels. Tr. 5724. In all other respects Mr. Dornbusch's production costs were reasonable and the same as used in the future project analysis. United States Exhibit WRIR C-278, pp. 3-12. (See Findings 303 through 308.)

328. Mr. Jacobs' production costs contained in Wyoming Exhibits EJ-3 and EJ-4 were unreasonable as in his future project analysis due to the use of unreasonably high equipment prices and use of a 320-farm size rather than a larger, more efficient tribal enterprise or co-op arrangement. (See Findings 304 through 306.) Wyoming Exhibit EJ-3, pp. 12, 13, 18, 19, Appendix A, EJ-4, pp. 2, 7, 8, 9, 10, Appendix IIA.

329. Mr. Dornbusch's production costs for the Type VIII lands were $155.39 per acre for malt barley, $158.68 per acre for nurse barley, $91.61 per acre for alfalfa, $184.66 per acre for corn silage and $159.13 per acre for corn grain. United States Exhibit WRIR C-278, p. 3, Tr. 5727.

330. Net returns in the Type VIII analysis were determined the same way as in the future project analysis. (See Findings 310.) Mr. Dornbusch's determination of $142.11 per acre for malting barley, $106.30 per acre for nurse barley, $155.07 per acre for alfalfa, $133.34 per acre for corn silage and $76.59 per acre for corn grain in the lowland area was reasonable. His determination of $115.01 per acre for malting barley, $81.91 per acre for nurse malt barley and $133.87 per acre for alfalfa in the highland area was reasonable. United States Exhibit WRIR C-278, p. 14.

331. The weighted average net returns for the Type VIII lands were computed using the net returns and the crop percent distribution. This is the same procedure used in the future project analysis. Mr. Dornbusch's determination of $140.04 per acre for the lowland area and $122.35 per acre for the highland area was reasonable. United States Exhibit WRIR C-278, p. 14, Tr. 5728.

332. The Type VIII lands were analyzed over a 100-year period, as were the future project lands. The same process for discounting the stream of annual benefits back to a present value was used. The same discount rate of four percent was used by Mr. Dornbusch in his analysis for future and Type VIII lands. Tr. 5729. (See Findings 311 through 315.)

333. Mr. Dornbusch determined a single present value for the 100-year stream of annual benefits for each of the Type

VIII areas using a four percent discount rate. His present value determinations of $3,501 per acre for the Coolidge, Johnstown, Subagency and Ray Units as well as the Arapahoe Ranch area was reasonable. His present value determination of $3,059 per acre for the Upper Wind Unit was reasonable. These present values were determined in the same manner as those in the future project analysis. United States Exhibit WRIR C-278, pp. 14 and 16, Tr. 5738. (See Findings 311.)

334. Mr. Dornbusch determined a present value using a four percent discount rate for Dr. Mesghinna's Type VIII irrigation systems, as well as for land preparation and fencing the same way as in his future project analysis. (See Findings 311 through 318.) Tr. 5731-34.

335. Mr. Dornbusch's present value determination for the total Type VIII irrigation system costs of $2,361 per acre for the Coolidge Unit, $2,064 per acre for the Johnstown Unit, $2,188 per acre for the Upper Wind Unit, $2,470 per acre for the Subagency Unit, $2,834 per acre for the Ray Unit and $3,311 per acre for the Arapahoe Ranch area was reasonable. United States Exhibit WRIR C-278, p. 16, Tr. 5737.

336. Benefit cost ratios were developed for each separate area studied in the Type VIII analysis. Mr. Dornbusch's determination of benefit cost ratios of 1.48 for the Coolidge Unit, 1.70 for the Johnstown Unit, 1.40 for the Upper Wind Unit, 1.42 for the Subagency Unit, 1.24 for the Ray Unit and 1.06 for

the Arapahoe Ranch area was reasonable. United States Exhibit WRIR C-278, p. 16, Tr. 5739.

337. Mr. Dornbusch has made a reasonable determination that the following acreages in the designated areas are economically feasible to develop and irrigate.

Coolidge Unit	200 Acres
Johnstown Unit	190 Acres
Upper Wind Unit	492 Acres
Subagency Unit	306 Acres
Ray Unit	28 Acres
Arapahoe Ranch	245 Acres
TOTAL	1,461 Acres

These are the same acreages that Dr. Mesghinna designed irrigation and drainage systems, and computed water requirements for in United States Exhibit WRIR C-277, p. 4.

338. Mr. Dornbusch's analysis for the Type VII lands was conducted in a similar manner to the analyses for the Type VIII and future project areas with the following exceptions:

a. lands were analyzed for flood irrigation as well as sprinkler, Tr. 5739;

b. some Class 4 land was included and the analysis recognized the effect of the lower land quality, Tr. 5740;

c. some lands were located in areas where a full supply of water is often not available throughout the irrigation season, and a limitation on the productive capacity of those lands was considered, Tr. 5740;

d. corn was eliminated from the crop mix due to the scattered arrangement and small size of the parcels, Tr. 5741;

e. different crops were considered for the water short and Class 4 lands, Tr. 5741-43;

f. soil amendment costs were considered where necessary, Tr. 5755-5757;

g. separate benefit cost analyses were performed for each Type VII parcel, Tr. 5755;

All exceptions had the effect of increasing the production costs and/or reducing the benefits. Under the circumstances Mr. Dornbusch's adjustments were reasonable.

339. The crop selection and mix used by Mr. Dornbusch in the Type VII analysis for lands classified 1-3 within the federal irrigation project areas of 17 percent malt barley, 16 percent nurse barley and 67 percent alfalfa was reasonable. United States Exhibit WRIR C-278, p. 36.

340. The crop selection and mix used by Mr. Dornbusch in the Type VII analysis for lands classified 1-3 outside the federal irrigation project with full water supply of 17 percent malt barley, 16 percent nurse barley, and 67 percent alfalfa was reasonable. United States Exhibit WRIR C-278, p. 36.

341. The crop selection and mix used by Mr. Dornbusch in the Type VII analysis for lands classified 1-3 outside the federal irrigation project in water short areas of 20 percent nurse oat hay and 80 percent alfalfa was reasonable. United States Exhibit WRIR C-278, p. 36.

342. The crop selection and mix used by Mr. Dornbusch in the Type VII analysis for all Class 4 lands of 8 percent nurse oat hay and 92 percent grass hayland was reasonable. United States Exhibit WRIR C-278, p. 37.

343. It was reasonable for Mr. Dornbusch to use the same 5900 ft. elevation breakpoint for yield reduction due to growing season for the Type VII analysis as he did for the Type VIII and future project analyses. Tr. 5728. (See Findings 295, 299 and 325.)

344. In determining the gross returns per acre for full irrigation Type VII lands, Mr. Dornbusch used reasonable yields attainable in the lowlands of 100 bushels per acre for malt barley, .75 tons per acre for baled barley straw, 88 bushels per acre for nurse barley, 4.5 tons per acre for alfalfa, 1.5 AUM's for alfalfa aftermath, 3 tons per acre for nurse oat hay, 3 tons per acre for grass hay and 1.5 AUM's for grass hay grazing. United States Exhibit WRIR C-278, p. 18.

345. In determining the gross returns for full irrigation Type VII lands Mr. Dornbusch used reasonable yields attainable in the highlands of 90 bushels per acre for barley, .75 tons per acre for baled barley straw, 79 bushels per acre for nurse barley, 4.1 tons per acre for alfalfa, 1.5 AUM's for alfalfa aftermath, 2.7 tons per acre for nurse oat hay, 2.7 tons per acre for grass hay and 1.5 AUM's for grass hay grazing. United States Exhibit WRIR C-278, p. 18.

346. In determining the gross returns per acre for water short Type VII lands classified 1-3, Mr. Dornbusch used reasonable attainable yields in the lowlands of 2.7 tons per acre for nurse oat hay, 2.7 tons per acre for alfalfa, and 1.5 AUM's for alfalfa aftermath. United States Exhibit WRIR C-278, p. 19.

347. In determining the gross returns per acre for Class 4 water short Type VII lands, Mr. Dornbusch used reasonable attainable yields in the lowlands of 2.3 tons per acre for nurse oat hay, 2.3 tons per acre for grass hay and 1.0 AUM's for grass hay grazing. United States Exhibit WRIR C-278, p. 19.

348. In determining the gross returns per acre for water short Type VII lands classified 1-3, Mr. Dornbusch used reasonable attainable yields in the highlands of 2.4 tons per acre for nurse oat hay, 2.4 tons per acre for alfalfa, and 1.5 AUM's for alfalfa aftermath. United States Exhibit WRIR C-278, p. 19.

349. In determining the gross returns per acre for Class 4 water short Type VII lands, Mr. Dornbusch used reasonable attainable yields in the highlands of 2.0 tons per acre for nurse oat hay, 2.0 tons per acre for grass hay and 1.0 AUM's for grazing grass hay. United States Exhibit WRIR C-278, p. 19.

350. The 1979 normalized prices used by Mr. Dornbusch in the Type VII analysis were reasonable. They were $2.71 per bushel for malt barley, $35.33 per ton for baled barley straw, $2.71 per bushel for nurse barley, $52.99 per ton for alfalfa, $5.48 per AUM for alfalfa aftermath, $52.99 per ton for nurse oat hay, $52.99 per ton for grass hay and $5.48 per AUM for grazing of grass hay.

351. The annual gross returns found by Mr. Dornbusch for the Type VII, lowland area with full service irrigation was reasonable. Those annual gross returns were $271.00 per acre for malt barley, $26.50 per acre for baled barley straw, $238.48 per acre for nurse barley, $238.46 per acre for alfalfa, $8.22 per acre for alfalfa aftermath, $158.97 per acre for nurse oat hay, $158.97 per acre for grass hay and $8.22 per acre for grazing grass hay. United States Exhibit WRIR C-278, p. 18.

352. The annual gross returns found by Mr. Dornbusch for the Type VII, highland areas with full service irrigation were reasonable. Those annual gross returns were $243.90 per acre for malt barley, $26.50 per acre for baled barley straw, $214.09 per acre for nurse barley, $217.26 per acre for alfalfa, $8.22 per acre for alfalfa aftermath, $143.07 per acre for nurse oat hay, $143.07 per acre for grass hay and $8.22 per acre for grazing grass hay. United States Exhibit WRIR C-278, p. 18.

353. The annual gross returns per acre found by Mr. Dornbusch for the Type VII, water short, Class 1-3, lowland areas were reasonable. Those annual gross returns were $143.07 per acre for nurse oat hay, $143.07 per acre for alfalfa and $8.22 per acre for alfalfa aftermath. United States Exhibit WRIR C-278, p. 19.

354. The annual gross returns per acre found by Mr. Dornbusch for the Type VII, Class 4, water short lowland areas

were reasonable. Those annual gross returns were $121.88 per acre for nurse oat hay, $121.88 per acre for grass hay and $5.48 per acre for grazing grass hay. United States Exhibit WRIR C-278, p. 19.

355. The annual gross returns per acre found by Mr. Dornbusch for the Type VII, water short, Class 1-3 highland areas were reasonable. Those annual gross returns were $127.18 per acre for nurse oat hay, $127.18 per acre for alfalfa and $8.22 per acre for alfalfa aftermath. United States Exhibit WRIR C-278, p. 19.

356. The annual gross returns per acre found by Mr. Dornbusch for the Type VII, Class 4, water short highland areas were reasonable. Those annual gross returns were $105.98 per acre for nurse oat hay, $105.98 per acre for grass hay and $5.48 per acre for grazing grass hay. United States Exhibit WRIR C-278, p. 19.

357. It was reasonable for Mr. Dornbusch to make the same adjustment to farm labor costs in the Type VII analysis as he did in the Type VIII and future project analyses. This adjustment costed 80 percent of farm labor at zero opportunity cost and 20 percent of farm labor at full opportunity cost, and costed management labor according to the same ten year phase-in period as in the future project analysis. Tr. 4985-89; 5724-25; 5907-14; 5925-26; 5934-43; Wyoming Exhibit ED-52. (See Findings 303 and 326.)

358. It was reasonable and prudent for Mr. Dornbusch to increase his production costs on the Type VII lands outside of the federal irrigation projects to account for extra equipment movement due to the isolated nature of the parcels. Tr. 5744. It was also reasonable to increase production costs to account for soil amendments where necessary and to account for lower operating efficiencies on the smaller parcels. Tr. 5755-57. In all other respects Mr. Dornbusch's production costs were the same as those used in the Type VIII and future project analyses. United States Exhibit WRIR C-278, pp. 21-34.

359. Mr. Jacobs' production costs contained in Wyoming Exhibits EJ-14 and EJ-15 were unreasonable as in the future project analysis due to the use of unreasonably high equipment prices and use of 320-acre farm size rather than a larger more efficient tribal enterprise or co-op arrangement. (See Findings 306 through 307.) Inclusion of beans in the cropping pattern also contributed to unreasonably high production costs by Mr. Jacobs, by adding to the farm budgets the high purchase price of specialized equipment that would be used on relatively few acres each year. Wyoming Exhibits EJ-14, pp. 3, 4, 7, 8, 10, Appendix A, EJ-15, pp. 2-4, 7, 8, 10, Appendix A, Tr. 14840-96, 14719-21.

360. The production costs determined by Mr. Dornbusch for Type VII, full water supply, sprinkler irrigation, inside the federal irrigation projects were reasonable. Those per acre costs were $155.39 for malt barley, $158.68 for nurse barley,

$91.61 for alfalfa, $131.98 for nurse oat hay and $78.29 for grass hay. United States Exhibit WRIR C-278, p. 20.

361. The production costs determined by Mr. Dornbusch for Type VII, full water supply, sprinkler irrigation, outside of the federal irrigation projects were reasonable. Those per acre costs were $156.99 for malt barley, $160.19 for nurse barley, $92.65 for alfalfa, $133.46 for nurse oat hay, and $79.20 for grass hay. United States Exhibit WRIR C-278, p. 20.

362. The production costs determined by Mr. Dornbusch for Type VII, full water supply, flood irrigation, inside the federal irrigation projects were reasonable. Those per acre costs were $156.52 for malt barley, $160.19 for nurse barley, $91.63 for alfalfa, $133.49 for nurse oat hay, and $77.49 for grass hay land. United States Exhibit WRIR C-278, p. 21.

363. The production costs determined by Mr. Dornbusch for Type VII, full water supply, flood irrigation, outside of the Federal Irrigation Projects were reasonable. Those per acre costs were $158.33 for malt barley, $161.91 for nurse barley, $93.39 for alfalfa, $134.97 for nurse oat hay and $78.40 for grass hay land.

364. The production costs determined by Mr. Dornbusch for Type VII, water short flood irrigation, Class 1-3 land was reasonable. Those per acre costs were $128.03 for nurse oat hay and $69.19 for alfalfa. For Class 4 land the per acre production costs were $133.83 for nurse oat hay and $77.53 for grass hayland. United States Exhibit WRIR C-278, p. 22.

365. Net returns for the Type VII lands were computed the same way as in the Type VIII and future project analyses. (See Findings 310 and 331.) Mr. Dornbusch's determination of net returns for full water supply, sprinkler irrigation, Type VII lowlands inside the federal irrigation projects was reasonable. Those per acre net returns were malt barley $142.11, nurse barley $106.30, alfalfa $155.07, nurse oat hay $35.21, and grass hay $80.68. United States Exhibit WRIR C-278, p. 20.

366. Mr. Dornbusch's determination of net returns for full water supply, sprinkler irrigation, Type VII lowlands outside of the federal irrigation projects was reasonable. Those per acre net returns were malt barley $140.51, nurse barley $104.79, alfalfa $154.03, nurse oat hay $33.73, and grass hay $79.77. United States Exhibit WRIR C-278, p. 20.

367. Mr. Dornbusch's determination of net returns for full water supply, sprinkler irrigation, Type VII highlands inside the federal irrigation projects was reasonable. Those per acre net returns were $115.01 for malt barley, $81.91 for nurse barley, $133.87 for alfalfa, $19.31 for nurse oat hay and $64.78 for grass hay. United States Exhibit WRIR C-278, p. 20.

368. Mr. Dornbusch's determination of net returns for full water supply, sprinkler irrigation, Type VII highlands outside of the federal irrigation projects was reasonable. Those per acre net returns were $113.41 for malt barley, $80.40 for nurse barley, $132.83 for alfalfa, $17.83 for nurse oat hay and $63.87 for grass hay.

369. Mr. Dornbusch's determination of net returns for full water supply, flood irrigation, Type VII lowland inside of the federal irrigation projects was reasonable. Those per acre net returns were $140.98 for malt barley, $104.79 for nurse barley, $154.75 for alfalfa, $25.48 for nurse oat hay and $89.70 for grass hay. United States Exhibit WRIR C-278, p. 21.

370. Mr. Dornbusch's determination of net returns for full water supply, flood irrigation, Type VII lowland outside of the Federal Irrigation Projects was reasonable. Those per acre net returns were $139.17 for malt barley, $103.07 for nurse barley, $153.29 for alfalfa, $24.00 for nurse oat hay and $88.79 for grass hay. United States Exhibit WRIR C-278, p. 21.

371. Mr. Dornbusch's determination of net returns for full water supply, flood irrigation, Type VII highland inside of the federal irrigation projects was reasonable. Those per acre net returns were $113.88 for malt barley, $80.40 for nurse barley, $133.55 for alfalfa, $9.58 for nurse oat hay and $73.80 for grass hay. United States Exhibit WRIR C-278, p. 21.

372. Mr. Dornbusch's determination of net returns for full water supply, flood irrigation, Type VII highland outside of the federal irrigation projects was reasonable. Those per acre net returns were $112.07 for malt barley, $78.68 for nurse barley, $132.09 for alfalfa, $8.10 for nurse oat hay and $72.89 for grass hay. United States Exhibit WRIR C-278, p. 21.

373. Mr. Dornbusch's determination of net returns for water short flood irrigation, Type VII lowland, Class 1-3 lands was reasonable. Those per acre returns were $15.04 for nurse oat hay and $82.10 for alfalfa. United States Exhibit WRIR C-278, p. 22.

374. Mr. Dornbusch's determination of net returns for water short flood irrigation, Type VII highland, Class 1-3 lands was reasonable. Those per acre net returns were -$.85 for nurse oat hay and $66.21 for alfalfa. United States Exhibit WRIR C-278, p. 22.

375. Mr. Dornbusch's determination of net returns for water short flood irrigation, Type VII, Class 4 lowlands was reasonable. Those per acre net returns were -$11.95 for nurse oat hay and $49.83 for grass hay. United States Exhibit WRIR C-278, p. 22.

376. Mr. Dornbusch's determination of net returns for water short flood irrigation, Type VII, Class 4 highlands was reasonable. Those per acre net returns were -$27.85 for nurse oat hay and $33.98 for grass hay. United States Exhibit WRIR C-278, p. 22.

377. The weighted average net returns for the Type VII lands were computed by using the crop percent distribution and the net returns. This is the same method used in this Type VIII and future project analyses. (See Findings 310 and 331.)

378. The weighted average net returns computed by Mr.

Dornbusch for Type VII, full water supply, land Class 1-3, sprinkler irrigation inside of the federal irrigation projects was reasonable. Those per acre costs were $145.06 for lowland and $122.35 for highland. United States Exhibit WRIR C-278, p. 36.

379. The weighted average net returns computed by Mr. Dornbusch for Type VII, full water supply, land Class 1-3, flood irrigation inside of the federal irrigation projects as reasonable. Those per acre costs were $144.42 for lowland and $121.70 for highland. United States Exhibit WRIR C-278, p. 36.

380. The weighted average net returns computed by Mr. Dornbusch for Type VII full water supply, land Class 1-3, sprinkler irrigation outside of the federal irrigation projects was reasonable. Those per acre costs were $143.85 for lowland and $121.14 for highland. United States Exhibit WRIR C-378, p. 36.

381. The weighted average net returns computed by Mr. Dornbusch for Type VII, full water supply, land Class 1-3, flood irrigation outside of the federal irrigation projects was reasonable. Those per acre costs were $142.85 for lowland and $120.14 for highland. United States Exhibit WRIR C-278, p. 36.

382. The weighted average net returns computed by Mr. Dornbusch for Type VII water short, land Class 1-3, flood irrigation, was reasonable. Those per acre costs were $68.69 for lowland and $52.80 for highland. United States Exhibit WRIk C-278, p. 36.

383. The weighted average net returns computed by Mr. Dornbusch for Type VII full water supply, Class 4, sprinkler

irrigation inside of the federal irrigation projects was reasonable. Those per acre costs were $77.04 for lowland and $61.14 for highland. United States Exhibit WRIR C-278, p. 37.

384. The weighted average net returns computed by Mr. Dornbusch for Type VII full water supply, Class 4, flood irrigation inside of the federal irrigation projects was reasonable. Those per acre costs were $84.56 for lowland and $68.66 for highland. United States Exhibit WRIR C-278, p. 37.

385. The weighted average net returns computed by Mr. Dornbusch for Type VII full water supply, Class 4, sprinkler irrigation outside of the federal irrigation projects was reasonable. Those per acre costs were $76.09 for lowland and $60.19 for highland. United States Exhibit WRIR C-278, p. 37.

386. The weighted average net returns computed by Mr. Dornbusch for Type VII full water supply, Class 4, flood irrigation outside of the federal irrigation projects was reasonable. Those per acre costs were $83.61 for lowland and $67.71 for highland. United States Exhibit WRIR C-278, p. 37.

387. The weighted average net returns computed by Mr. Dornbusch for Type VII water short, Class 4, flood irrigation outside of the federal irrigation projects was reasonable. Those per acre costs were $44.89 for lowland and $22.99 for highland. United States Exhibit WRIR C-278, p. 37.

388. The Type VII lands were analyzed over a 100-year period, as were the Type VIII and future project lands. The same general process for discounting the stream of annual benefits

back to a present value was followed, using a discount rate of four percent. A three step process was used in determining present value of net benefits for the Type VII lands. Net benefits were first computed by considering location, land class, water supply and elevation. United States Exhibit WRIR C-278, p. 38. Thereafter, those net benefits were applied on a parcel by parcel basis using the appropriate values for each parcel. Tr. 6182. Mr. Dornbusch's determination of present values for benefits or returns by drainage basin are reasonable. See Table following Findings 390.

389. Mr. Dornbusch determined a present value for each Type VII parcel for which irrigation system development costs were developed by Mr. Stetson, in the same general manner as in the Type VIII and future project analyses. (See Findings 311 through 318 and 332 through 335.) Tr. 5746-60, 6107-08. The present values for the irrigation system development costs computed by Mr. Dornbusch are summarized in the table following Findings 390 are reasonable.

390. Benefit cost ratios were developed for each separate Type VII parcel. The ratios from the feasible parcels were then used to compute an average ratio for each drainage basin. The feasible acreage, present value per acre returns

and costs and the benefit cost ratios computed by Mr. Dornbusch, which are reasonable are contained in the following table:

TYPE VII IRRIGABLE LANDS

Description	Feasible Acres	Per Acre Returns (Present Value)	Per Acre Costs (Present Value)	B/C Ratio
1. Wind River Federal Irrigation Project				
A. Little Wind River [15/]	1,769	3,128	948	3.30
Ray Unit	1,161	3,250	885	3.67
Coolidge Unit	200	3,524	1,274	2.77
Subagency Unit				
B. Upper Wind Unit [16/]				
Wind River 'A' Canal	99	2,428	1,084	2.24
Dinwoody Bench Area	393	2,956	642	4.60
C. Johnstown Unit [17/]	189	1,560	278	5.61
D. Lefthand Unit [17/]	587	3,484	1,142	3.05
Subtotal	4,398	-----	-----	----
2. LeClair Irrigation District[3]				
A. Trust Lands	100	3,484	410	8.50
Subtotal	100	-----	---	----
Total Project Lands	4,498	-----	---	----

15/ Water sources include North Fork Little Wind River, South Fork Little Wind River, Little Wind River, Trout Creek and Mill Creek.

16/ Water sources include Wind River, Dinwoody Creek, Dry Creek, Meadow Creek and Willow Creek.

17/ Water source is Wind River.

TYPE VII IRRIGABLE LANDS (Continued)

Description	Feasible Acres	Per Acre Returns	Per Acre Costs	B/C Ratio
Non-Project Lands				
1. Wind River Federal Basin				
A. East Fork Wind River	41	$1,606	1,185	1.36
B. Dry Creek	4	2,917	308	9.47
C. Bull Lake Creek	37	3,484	499	6.98
D. Meadow Creek	160	2,917	600	4.86
E. Dry (Pasup) Creek	115	1,201	664	1.81
F. Crow Creek	154	1,135	617	1.84
G. Wind River Main Stem	213	3,062	1,246	2.46
Subtotal	724	-----	-----	----
2. Little Wind River Basin				
A. North Fork Little Wind	357	2,703	815	3.32
B. South Fork Little Wind	44	2,834	277	10.23
C. Main Stem Little Wind	805	3,308	1,462	2.26
D. Mill Creek	10	1,606	1,048	1.53
E. Sage Creek	822	1,233	536	2.30
F. Crooked Creek	3	1,606	716	2.24
G. Trout Creek	63	2,003	422	4.75
Subtotal	2,104	-----	---	----
3. Bighorn River Basin				
A. Main Stem Bighorn River	24	$3,484	220	15.84
B. Cottonwood Creek	117	1,710	383	4.46
C. Muddy Creek	186	1,333	577	2.31
Subtotal	327			

TYPE VII IRRIGABLE LANDS (Continued)

Description	Feasible Acres	Per Acre Returns	Per Acre Costs	B/C Ratio
4. Popo Agie River Basin				
A. North Fork Popo Agie	102	3,279	2,950	1.11
Subtotal	102			
5. Owl Creek Basin				
A. South Fork Owl Creek	64	1,233	672	1.8
B. Main Stem Owl Creek	87	1,630	929	1.75
C. Mud Creek	40	1,620	633	2.56
Subtotal	191			
Total Non-Project Lands	3,448			
TOTAL TYPE VII	7,946			

391. Mr. Dornbusch has made a reasonable determination that the acreages contained in the foregoing table are economically feasible to develop and irrigate. These acreages contain various adjustments made to those acreage totals testified to by Mr. Stetson.

VI. DEPLETION AND NATURAL FLOW STUDIES

392. As a foundation for a hydrologic study of the Wind River Basin, Mr. Robert Toedter, an agricultural engineer employed by H.K.M. Associates and one of the United States' experts, performed a net "depletion analysis" to determine the amount of water historically consumed by agricultural crops and by non-beneficial plant use and to account for the redistribution of flow from historic return flow patterns.

393. A depletion analysis is an essential step in determining the "natural" or "virgin" flow of a stream or stream system where there historically has been substantial irrigation activity by man. Depletion estimates were limited to agricultural depletions because all other depletions were found to be insignificant. The depletion analysis attempts to determine the amount of water consumed and redistributed as a result of irrigation, thereby enabling one to determine the amount of flow in a stream or stream system that would occur naturally in the absence of man's artificial irrigation.

394. In his depletion analysis, Mr. Toedter estimated depletions on a month by month, year by year, basis from 1918 to 1979 for certain key points (sometimes referred to as points of interest) in the upper portion of the Wind River Basin. Specifically, net agricultural depletions were developed for: North Fork of the Little Wind; South Fork of the Little Wind; Trout Creek; North Fork of the Popo Agie; Little Popo Agie; Wind River near

Burris; East Fork Wind River near Burris; Dinwoody Creek; Dry Creek; Meadow Creek; Willow Creek; Bull Lake Creek; Wind River near Crowheart; and Wind River near Burris. The depletion study area consists of the area from which the bulk of the water supply of the Wind River Basin is derived. Some points of interest were located outside the reservation boundary because, in order to determine the natural water supply on the reservation, it is necessary to take into account depletions from streams occuring before they enter the reservation.

395. Once Mr. Toedter had developed his estimates of depletions from 1918 to 1979, he gave the information to Mr. Michael Keene, who utilized it in his natural flow study.

396. Neither the methodology used by Mr. Toedter nor the estimates for depletions that resulted were criticized by the witnesses who testified on behalf of the State of Wyoming.

397. Michael Keene, an expert in hydraulics and hydrological engineering and an employee of H.K.M. Associates, testified on behalf of the United States.

398. Mr. Keene undertook two studies. The first study was a natural or virgin flow analysis to determine the hydrologic potential and characteristics of the Wind River Basin. Tr. 7056. The geographic scope of the natural flow study spanned from the westerly most portion of the Wind River Basin, through the basin, and included a small portion of the Big Horn Basin upstream from the confluence of Owl Creek and downstream of the Wind River Canyon.

Tr. 7052. The second study done by Mr. Keene, at the request of Mr. Billstein, was a study of the hydrological characteristics of individual stream reaches.

399. "Natural flows" are flows that occur in a stream as affected only by natural influences. Historic flows are flows measured at a gauging site in a stream and reflect the stream flows as affected by man's activity in the basin. Tr. 7051.

400. In his natural flow study, Mr. Keene undertook a detailed study of those sites that he and Mr. Billstein felt were essential to determine the hydrologic potential of the Wind River Basin. Tr. 7056. The detailed study sites in the westerly and southerly portions of the Wind River Basin and in the higher altitudes. They are the same sites studied by Mr. Toedter in his depletion analysis. Tr. 7066. These detailed study sites are sometimes referred to as "A.1." sites in the testimony in accordance with an outline developed by Mr. Keene and introduced into evidence as United States Exhibit WRIR C-296. In addition to the detailed study sites, Mr. Keene added other study areas during the course of his investigation when he felt it necessary in order to obtain a general hydrologic perspective of the basin. Tr. 7051. These study sites are sometimes identified in the transcript as A.2 and A.3 sites. The areas studied by Mr. Keene,

that is the A.1, A.2, and A.3 sites, are identified on the stream gauge map, United States Exhibit WRIR C-297.

401. With regard to the A.1, or detailed study sites, Mr. Keene added Mr. Toedter's depletion estimates (or subtracted the depletion estimates in those cases where, in winter months, there were return flows above a gauge which exceeded diversions) to the historic gauge reading at a particular site for the period of record at the gauge. Thus, although Mr. Toedter had depletion estimates for the entire period from 1918 to 1979, Mr. Keene at a particular gauge utilized only those estimates which coincided with the period of record of the gauge. Tr. 7068. This resulted in a determination of the natural flows at each gauge, but only for the period of record for each individual gauge. Tr. 7068-69.

402. The 1918-1979 period is based on the period of record of the U.S.G.S. gauge on Bull Lake Creek at Lenore. Tr. 7072. Mr. Keene reduced this study period to 1946 through 1979. Tr. 7072. This reduction was made because: many of the gauges for the detailed study sites (A.1) have continuous records for most of the 1946-79 period; the period contains representative monthly and annual averages and variations; because the period includes dry cycles and wet cycles and because the period is a relatively long period for a hydrologic study of this nature. Tr. 7073.

403. If a gauge in an A.1 site had an incomplete record for any period, Mr. Keene filled in the missing information through a statistical analysis developed through the use of prediction equations (Tr. 7081) to determine natural flows for the period when there were no historic records. Tr. 7074.

404. Using the above analysis, Mr. Keene developed monthly stream flow values on a natural or virgin flow basis for the study base period of 1946 through 1979 on a water year basis for the A.1 sites.

405. Mr. Keene also estimated the mean monthly flows for the period of 1946 to 1979 for the "A.2" sites. Tr. 7087. These sites were referred to as bookkeeping sites by Mr. Keene to step downstream from the A.1 detailed study sites. The detailed procedures are presented in United States Exhibit WRIR C-301. The A.2 sites did not receive as detailed analysis as the A.1 sites and no independent depletion analysis was done for these sites.

406. "A.3" study sites are sites where the recorded flows equal the historic flows; that is where there are no man-made agricultural depletions. United States Exhibit WRIR C-296. For these sites Mr. Keene determined the mean monthly flows for each month from 1946 to 1979, using the same statistical analysis

used with regard to A.1 sites to fill in any period for which there was no record. Tr. 7088-89.

407. United States Exhibit WRIR C-300 is a schematic of the long term average natural flows through the Wind River Basin based on Mr. Keene's study of the A.1, A.2, and A.3 sites.

408. Mr. Keene turned over to Mr. Billstein his estimates of long term average natural flows and the mean monthly natural flows for the period of 1946-1979. Tr. 7091.

409. United States Exhibit C-299 is a schematic of the historic average flows of the Wind River Basin as determined by Mr. Keene. Tr. 9093. The historic averages shown on the exhibit do not have a common study base period like the natural flow study. Tr. 7094.

410. The "additional study sites" identified by Mr. Billstein were not part of the natural flow analysis. They are broken down into "B.1" and "B.2" sites and are identified on United States Exhibit WRIR C-298. The B.1 study sites have no gauges and their flows were estimated using accepted prediction equations, isogram maps published by the U.S.G.S., channel geometry, and precipitation to determine runoff. Tr. 7103. For the B.1 sites, Mr. Keene developed only a long term average estimate of natural flows and did not attempt to develop natural flows for each month from 1946 to 1979. Mr. Keene also estimated the average distribution of his estimated average annual natural flows for the B.1 sites and provided that information to Mr. Billstein. Tr. 7105.

411. For the B.2 study area, the Owl Creek basin, Mr. Keene estimated monthly natural flow immediately downstream from the confluence of the North Fork and South Fork of Owl Creek. He also performed a "percent yield analysis" identifying the 50 percent chance flows, the 60 percent chance flows, and the 80 percent chance flows at a point on the South Fork of Owl Creek immediately upstream of the confluence of the North and South Forks and at a point on Owl Creek immediately downstream from the confluence. Tr. 7108. For each B.2 site Mr. Keene provided mean monthly flows for the period of record (Tr. 7109) and the percent yield results to Mr. Billstein. Tr. 7110.

412. Mr. Keene's findings and conclusions with respect to the "B" sites are contained in United States Exhibit WRIR C-301. Tr. 7112.

413. United States Exhibit WRIR C-302 sets out the monthly natural stream flows for the "A" sites for each month in the study period, 1946-1979. Tr. 7127-28.

VII. WATER AVAILABILITY

414. A detailed systems operation study was conducted by Ron Billstein, an expert in water resources planning, to determine whether there was a sufficient supply of water available in the rivers and streams passing through the Wind River Indian Reservation to service all of the agricultural, industrial, municipal and fishery claims presented by the United States' experts. Tr. 7214-7412, 7543, United States Exhibit WRIR C-305.

415. Mr. Billstein's study utilized the acreages and/or water demands presented by: Dr. Mesghinna and Mr. Stetson for the agricultural claims; Mr. Merchant for the municipal and industrial claims; and Mr. Vogel for the fishery claims. Tr. 7234, 7385, 7393, United States Exhibit WRIR C-306. A priority date of 1868 was used by Mr. Billstein for all claims presented by the United States. Tr. 7287, 7290.

416. Mr. Billstein's study assessed the water demands against the water supply information presented by Mr. Keene. Appropriate hydrologic base periods were utilized in the respective studies. A 34-year period was incorporated into the operational studies conducted for the Big Wind River, Little Wind River and Popo Agie River - Little Wind River - Bighorn River Study Units. The historic period of record was used for the Owl Creek study. Long term average runoff statistics were utilized for the minor tributaries. United States Exhibit WRIR C-301, Tr. 7233-34, 7258, 7270, 7302, 7308, 7310, 7313, 7319-20, 7325, 7355, 7363.

417. Mr. Billstein's study accounted for appropriate agricultural return flows. This information was complied jointly between Mr. Billstein and Mr. Toedter to account for quantity, location and monthly distribution. Tr. 7243-53, 7407-08, United States Exhibit WRIR C-294.

418. Mr. Billstein's analysis was conducted using an HEC-3 computer program. This technique is generally accepted in the profession to conduct a water availability analysis. Tr. 7255-56. The HEC-3 program allows for reservoir operation, accounts for inflows, demands, depletions, and return flows while continuously monitoring the remaining riverflow month by month in the downstream direction for the base period. Tr. 7256, 7436.

419. The river flow, water demands and return flows were accounted for systematically at various control points established by Mr. Billstein. Existing reservoirs (Ray Lake, Washakie Reservoir) were operated in the Little Wind River Study. Tr. 7257-58, 7262-70, 7296. Mr. Billstein established 39 control points for the Big Wind Study area, United States Exhibit WRIR C-307, 29 control points for the Little Wind Study area, United States Exhibit WRIR C-308, and 11 control points to assess the agricultural and fishery claims associated with the Popo Agie - Little Wind River - Bighorn River Study Unit. United States Exhibit WRIR C-316.

420. The agricultural water claims of the United States were evaluated in five separate studies using appropriate techniques, and data. The five studies were:

a. Big Wind River operational study;

b. Little Wind River operational study;

c1. Comparison of natural flows for the base period versus agricultural demand for the Popo Agie River - Little Wind River - Bighorn River Study Units.

c2. Popo Agie River - Little Wind River - Bighorn River operational study

d. Comparison of the timing of natural flows versus agricultural demands for the minor tributaries associated with water short drainages

e. Comparison of available flow, in terms of recurrence interval, to agricultural water demand for the main stem Owl Creek Study area. The study unit consisted of the lands south of Owl Creek along the South Fork of Owl Creek plus the main stem of Owl Creek below the confluence of the North and South Forks of Owl Creek

Tr. 7231-33, 7258-76, 7295-7301, 7307-08, 7310, 7312-18, 7353, 7360-72.

421. In the Big Wind River Operational Study, out of the hydrologically representative 34 year period that was studied, there were only a few months in a few years that there was not enough water to meet the ideal demands set by the agricultural engineers. The shortage for the most critical low flow month of record was but 8 percent of required demand. Implementing a reasonable 10-15 percent increase in irrigation efficiencies for only

a selected portion of the watershed (Upper Wind Unit of the FIP), Mr. Billstein confirmed that all acreage claimed by the United States could be served during this severe drought period. This is a manageable shortage. Tr. 7278-82, 7285-86.

422. Mr. Billstein researched how water shortages were handled in the area and found that it was the practice in the area during drought periods to increase irrigation efficiencies and utilize carryover soil moisture to meet irrigation requirements. He found that when shortages occurred in dry years, management practices were historically implemented in Wind River Study area. Tr. 7280.

423. Mr. Billstein's findings were reasonable in light of the fact that, within the Big Wind River study area that he used, there is currently 116,000 acres being irrigated and the United States' claim in that same area is only for approximately 60,000 acres. Tr. 7286, 7291-92.

424. In Mr. Billstein's Little Wind River Operational Study the same procedure was followed using the HEC-3 computer program. It was proper for Mr. Billstein to account for and utilize the storage capacity of Washakie Reservoir and Ray Lake in this portion of the study. Tr. 7295-99.

425. In Mr. Billstein's study of the Little Wind River, using a representative 34 year period, there were 12 years where there were some months where there were shortages greater than 2 percent. Mr. Billstein found that by increasing irrigation

efficiencies by 10 - 15 percent, the shortages in those months could be managed and overcome. By management, all lands claimed by the United States could be served and agricultural demands met. This level of increase in efficiency had been carried out in the basin during the severe 1977 drought. Tr. 7303-05, United States Exhibit WRIR C-312.

426. Mr. Billstein's findings were reasonable in view of the fact that there were 34,000 acres currently under irrigation in the Little Wind Study area and that the United States' claim in the same area is for only 27,500 acres. Tr. 7305.

427. In Mr. Billstein's study of water availability for the Popo Agie - Little Wind River, Bighorn River Study area, a comparison was made between the agricultural demands and the available natural flow from Mr. Keene's A.1 study sites. This technique was proper because there were so few claims by the United States in the area. Tr. 7307-08. In addition, a system operation study was conducted for the same study unit to assess both agricultural and fishery demands versus natural flows. Tr. 7310.

428. Mr. Billstein found that over the representative 34 year period in the Big Horn River there were no years in which the United States agricultural claims could not be satisfied and, therefore, there was water available to serve those claims. Tr. 7308, 7311.

429. Mr. Billstein found that over the representative 34 year period in the Little Wind River, below the confluence with the Popo Agie, there were no years in which the United States' agricultural claims could not be satisfied and, therefore, there was water available to serve those claims. Tr. 7308, 7311.

430. Mr. Billstein found that in the North Fork of the Popo Agie there were only 4 out of 34 years in which there was one month in which the agricultural water demand could not be met. By increasing the irrigation efficiencies and by utilizing carryover soil moisture, he found that the shortages could be eliminated. Tr. 7309, 7311-12.

431. Mr. Billstein found no other water shortages in the remaining Popo Agie River System throughout the 34 year period and, therefore, there was water available to serve those agricultural claims. Tr. 7308, 7311.

432. Mr. Billstein's study of water availability for the Owl Creek area utilized only those lands for which the United States is seeking a priority date of 1868. The lands north of Owl Creek were not included in the study. The United States is claiming the State water rights for those lands and the date of acquisition. Tr. 7313-17.

433. The agricultural water demand of the lands within the Owl Creek study were compared to the hydrologic data contained within Mr. Keene's B.2 sites. Water supply was presented on a percent yield basis. An 80 percent recurrence interval flow was utilized for the water availability studies. This approach is accepted by the profession as a means of evaluating the availability of water and is reasonable for this study. Tr. 7317-20, United States Exhibit WRIR C-301, pp. 17-18, 27-29.

434. Mr. Billstein found that when the 80 percent flows were compared to the agricultural demand that the water requirements could be met 100 percent of the time in May, June, July and September for both individual study reaches in the Owl Creek anlaysis. However, a 60 percent recurrence interval flow was needed to meet the agricultural demands in August. Tr. 7320, 7356. He found that by increasing the irrigation efficiencies by 15 percent, he could eliminate the shortage under an 80 percent chance recurrent interval water supply. This was reasonable. Tr. 7320-22.

435. Mr. Billstein found through his research that the Owl Creek area traditionally has low water flows in August and found that the irrigators in the area compensate for the low August flows by increasing their irrigation efficiencies during that time. These are manageable shortages. Tr. 7321-22.

436. Mr. Billstein's findings of water availability in the South Fork of Owl Creek area were reasonable in view of the fact that there are 10,000 to 12,000 acres presently irrigated in the same study area and the United States' claim is for only 2,000 acres. Tr. 7322. Mr. Billstein's findings of water availabiity in the main stem below the confluence of the North and South Forks is reasonable in view of the fact that, while the United States is claiming 572 acres in the area, there are 1,000 acres being currently irrigated in the area. Tr. 7357.

437. Mr. Billstein and members of his staff, under his direction, conducted field interviews with farmers and Bureau of Indian Affairs water administrators on the Wind River Indian Reservation to assist in determining the timing and quantity of water flows in the minor tributaries that lie north of the Big Wind River. Such findings were used by Mr. Keene in his development of water supply for the Group B.1 sites. It was determined that due to the high spring run-off and later decline in flows, that the farming operations in the area are built around the early timing (May-July) of the flows. Tr. 7360-62.

438. This water supply versus agricultural demand information was given to Stetson Engineers and David Dornbusch & Company to use in the determination of cropping patterns, water requirements and economic returns in this area. Tr. 7363-64, 7373.

439. Water requirements for the acreage claimed in these sometimes water short drainages were compared to the water supply information collected and developed by Mr. Keene in the B.1 sites. Tr. 7362, 7371. Mr. Billstein's study did not take into account return flows. Tr. 7372. The results of Mr. Billstein's study showed that the agricultural demands were generally met in May and June, thereafter the flows receded with only a portion of the agricultural water requirements being met in July. Tr. 7371-73. This streamflow pattern was confirmed by Mr. Henry Sostrom, a consultant for the State of Wyoming. Tr. 12891. It was concluded that when runoff was occuring in the early irrigation season water was available for the government claims. Tr. 7372-73.

440. Mr. Billstein assessed surface water availability to serve the industrial claims made by the United States for secondary oil recovery (Tr. 7382), an ammonia plant (Tr. 7384), a phosphate processing plant, a coal-fired power plant, a wallboard plant (Tr. 7388), and a uranium processing plant. Tr. 7389. Mr. Billstein's opinion that there was enough surface water available to satisfy these claims and not conflict with the United States' agricultural claims. Tr. 7389. However, some management was required in the Crow Creek watershed to insure that a firm water supply was available for the uranium processing plant. Tr. 7390. The industrial claim can also be served from groundwater supplies. (See Findings 488-520.)

441. Mr. Billstein evaluated the municipal water requirements for the Indian populations of Ft. Washakie and Riverton (Tr. 7392). Mr. Billstein's finding that there was generally sufficient water available to meet these demands and that storage in Washakie Reservoir could be used if shortages existed at Fort Washakie. Tr. 7392-93.

442. Mr. Billstein conducted a study to determine whether the fishery flow requirements presented by Mr. Vogel could be satisfied after the agricultural water requirements were met. Tr. 7393. (See Findings 443-444.)

443. Mr. Billstein found that at some control points there was some conflict between the United States' agricultural water requirements and the fishery requirements. He categorized these as potential conflicts, minor conflicts and major conflicts. Tr. 7397-98, United States Exhibit WRIR C-309 through WRIR C-315.

444. At the time in the future when the Tribes reach maximum utilization of their water right and it such conflicts arise, a reasonable solution to these conflicts of water use is be for the Tribes to make a choice of which uses will be met.

VIII. AESTHETIC AND WILDLIFE

445. The United States has claimed water for maintenance of aesthetic values and wildlife habitat on the Wind River Indian Reservation. Tr. 110-120, 124-130, 133-142.

446. The geographical area of the claim is depicted on United States Exhibit WRIR C-7, Tr. 110-13.

447. The United States' aesthetic and wildlife claim includes the lands within the Wind River Reservation Roadless Area. Tr. 106-07, United States Exhibit WRIR C-6.

448. The aesthetics and wildlife claim of the United States was prepared by Richard Harbour, Land Operations Officer for the Bureau of Indian Affairs on the Wind River Indian Reservation. Tr. 111.

449. Mr. Harbour's official duties as Land Operations Officer include the care and planning of natural resource use on the reservation. He has been Land Operations Officer on the reservation for seven years, supervising specialists in soil and moisture conservation, forestry, range management, irrigation surface mining, and environmental investigations. Tr. 62-64.

450. Together with Mr. Harbour's official duties, his prior professional experience and personal background enable him to judge reservation lands for their aesthetic and wildlife values. Tr. 73-76, United States Exhibit WRIR C-1.

451. The United States' claims for aesthetics and wildlife are coextensive. United States Statement of Claims, pp. 13-15.

452. The aesthetics and wildlife claim includes high mountain areas containing lakes, streams and timber resources. The lands are colorful with high scenic value. Big game species found in the area are bighorn sheep, deer and elk. Tr. 113-14.

453. Steven Martin, Wyoming's wildlife expert, reviewed the United States' claim. From the standpoint of wildlife habitat, Mr. Martin concluded that Mr. Harbour's designation of the northern portion of the aesthetics and wildlife claim -- the Owl Creek Range area -- made sense, was carefully selected and was without fault. Tr. 114, 11237.

454. As to that portion of the Wind River Range included in the United States' aesthetics and wildlife claim, Mr. Martin concluded that some of the area in the lower elevations contained degraded wildlife habitat. While he could not concur in the lower elevation boundary of the Wind River Range area selected by Mr. Harbour, Mr. Martin was unprepared to say where the boundary should be and testified that improvements could be made to the quality of the lower elevation wildlife habitat. Tr. 11234, 11237, 11239, 11257-58.

455. Mr. Martin concluded that the designated roadless area served to enhance the quality of wildlife habitat and the populations of animals that occur in that part of the reservation. Tr. 11236.

456. Mr. Martin had no involvement at all in evaluating the United States' aesthetic claims. Tr. 11273.

457. The State's consultant on landscape aesthetics, Thomas Keith, reviewed the aesthetic value of the land in the United States' claim. Mr. Keith testified that in his opinion the United States' applied a "very individual" approach which resulted in what he considered to be an inconsistent evaluation of the aesthetics claim. Tr. 11408-09.

458. However, Mr. Keith concluded that on the basis of aesthetics alone, he concurred in 70 to 80 percent of Mr. Harbour's selection of lands in the aesthetics and wildlife claim. Those lands had either an A or B classification under the Visual Resource Management System of the Bureau of Land Management. Tr. 1152, 11411-12, 11510-11, 11522, 11535, United States Exhibit WRIR C-7, Wyoming Exhibit WRIR AK-1.

459. Mr. Keith reviewed the aesthetic quality of the roadless area designated in 25 CFR §163 and included in the United States' aesthetics and wildlife claim. He concluded that the bulk of it is of outstanding scenic quality and is undoubtedly spectacular country. Tr. 11475-76, United States Exhibits WRIR C-6, WRIR C-7.

460. Mr. Keith testified that some lands of high aesthetic value omitted by Mr. Harbour should have been included in the United States' claim, while others in the claim should be excluded. Tr. 11423-26. Nonetheless, Mr. Martin and Mr. Keith substantially concur with Mr. Harbour's selection of the aesthetics and wildlife area depicted in United States Exhibit WRIR C-7. The Court concludes

that the geographical area in that exhibit is reasonable and shall be the basis of the United States' claim to water for aesthetics and wildlife.

461. Gypsum and phosphate deposits occur in the area claimed by the United States for aesthetics and wildlife. Compare United States Exhibits WRIR C-7, WRIR C-26, WRIR C-27, WRIR C-28 and Wyoming Exhibit AK-1, Tr. 11420, 11471-72.

462. Mr. Keith testified that resource development need not be foregone in order to maintain the scenic value of the land involved. Tr. 11522.

463. The United States' witness, Mr. Harbour, concluded that all water sources should be maintained in their naturally occurring condition in the area subject to the aesthetics and wildlife claims in order to maintain aesthetic values and wildlife habitat. Tr. 115-16, 128-29.

464. The claims to water for aesthetics and wildlife are essentially non-consumptive except for that consumed by cattle and wildlife. Tr. 116, 120.

465. Mr. Martin testified that 30 percent of the average annual flow of the streams will provide good habitat quality for wildlife. Mr. Martin did not do any field work regarding lake levels in the claim area and testified that he found the United States' claim as to lake levels imprecise and ambiguous. Tr. 11248-49, 11257, 11262.

466. Mr. Martin considered using the Cooperative Instream Flow Group incremental methodology (used by the United States to support its fishery claims) to assess the water requirements for

wildlife habitat maintenance. He chose not to because in his opinion the methodology historically has not been applied to wildlife investigations, and he had neither the time nor the money to perform the necessary field work. Tr. 11239-41.

467. Mr. Martin instead used the Tenant method to reach his conclusion. Tr. 11240-48.

468. Mr. Martin made no independent investigation of groundwater levels but concluded that 30 percent of average annual instream flows would keep alluvial groundwater at levels which would sustain the growth and repoduction of trees and shrubs that comprise the riparian vegetation. Tr. 11251.

469. Mr. Keith testified as to aesthetics that 60 percent of the average annual flow would fully occupy a stream channel with water. That level of flow would maintain the aesthetic quality of the stream. Tr. 11462.

470. All evidence indicates that none of the claims to water for aesthetics and wildlife are expected to affect water use on fee lands. Tr. 114, 11237.

471. No party contends that instream flows less than 30 percent of the average annual flows would be sufficient to maintain aesthetic values and wildlife habitat. The Government's claim for 100 percent of the average annual flow is non-consumptive and has not been shown to interfere with existing or proposed water uses upstream or downstream of the area in United States Exhibit WRIR C-7, therefore the Government's claim is as follows: The entire flow of the following streams and other named and unnamed streams within the areas delineated on United States Exhibit WRIR C-7.

SPRINGS - Tributary Dry Muddy or Cottonwood Creek

FOUR MILE SPRINGS - Tributary Dry Muddy

TWO MILE SPRINGS - Tributary Dry Muddy or Cottonwood Creek

MORRISON SPRING - Tributary Dry Muddy or Cottonwood Creek

SPRINGS - Tributary Mexican Creek - Tributary Dry Muddy or Cottonwood Creek

INGALLS SPRINGS - Tributary Dry Muddy or Cottonwood

RED SPRINGS - Tributary Big Horn River

STANGER CREEK - Tributary Dry Muddy or Cottonwood Creek

SHEEP CREEK - Tributary Muddy Creek

WEST FORK SHEEP CREEK - Tributary Muddy Creek

EAST FORK - Tributary Muddy Creek

O'SHEA SPRINGS - Tributary East Fork Sheep Creek

EDMORE CREEK - Tributary Sheep Creek

SPRINGS CREEK - Tributary Edmore Creek

SHOTGUN CREEK - Tributary Muddy Creek

ALKALI SPRINGS - Tributary Shotgun Creek

FLOOD GULCH or DRAW - Tributary Shotgun Creek

WILLOW CREEK - Tributary Muddy Creek

ROUND-UP or WARMSPRINGS CREEK - Tributary Willow Creek

HOLLAND CREEK - Tributary Warm Springs Creek

MUDDY SPRING - Tributary Holland Creek

DEEP SPRINGS CREEK - Tributary Holland Creek

SPRING - Tributary Muddy Creek

DRY MUDDY CREEK - Tributary Muddy Creek

RED CREEK - Tributary Dry Creek

MEADOW CREEK - Tributary Big Wind River

SOUTH FORK MEADOW CREEK - Tributary Meadow Creek

BOBS CREEKS - Tributary Meadow Creek

SPRINGS GULCH - Tributary Crow Creek

DRY CREEK - Tributary Big Wind River

DINWOODY CREEK - Tributary Dinwoody Creek

RED CREEK - Tributary Big Wind River

SPRINGS - Tributary Meadow Creek

DRAW - Tributary Meadow Creek

PINE CREEK - Tributary Willow Creek - Tributary East Fork of North Fork Big Wind River

SPRING - Tributary Trout Creek

SOUTH FORK SAGE CREEK - Tributary Sage Creek

ST. CLAIR CREEK - Tributary South Fork Sage Creek

ST. LAWRENCE CREEK - Tributary Sage Creek

NORTH FORK SAGE CREEK - Tributary Sage Creek

LITTLE DRY CREEK - Tributary Dry Creek

SPRINGS - Tributary Owl Creek

MUD CREEK - Tributary Owl Creek

MIDDLE FORK MUD CREEK - Tributary Owl Creek

HIELSCHERS FORK OF MIDDLE FORK MUD CREEK - Tributary Owl Creek

SPRING DRAW - Tributary Mud Creek

SPRINGS - Tributary Mud Creek

NORTH FORK MUD CREEK - Tributary Mud Creek

SOUTH FORK MUD CREEK - Tributary Mud Creek

SPRING - Tributary of Owl Creek

SPRING - Tributary Owl Creek

IX. LIVESTOCK

472. James P. Merchant testified as an expert in economics on behalf of the United States with respect to the present and future water requirements for livestock and mineral development and municipal uses. Tr. 181-86, 230.

473. Dr. Robert Carver an expert in livestock management and economics testified on behalf of the State of Wyoming about the potential of livestock operations on the Wind River Reservation. Tr. 11886, 11893.

474. Mr. Merchant reviewed the existing livestock industry on and around the reservation and developed a model to forecast the economics of an expanded livestock industry on the reservation. In making his forecast, Mr. Merchant relied on a University of Wyoming study of mountain valley cattle ranching in Wyoming, U.S. Department of Agriculture publications, interviews with ranchers, Government and state officials and cattle marketing data. Tr. 186-190.

475. Mr. Merchant and Mr. Harbour concluded that the existing cattle population on the reservation is 25,000 head. Mr. Merchant's conclusion is based on information provided to him by the reservation's range and land operations officers who are BIA officials. United States Exhibit WRIR C-17, Tr. 101, 374, 379, 381-83.

476. Dr. Carver concluded that the existing cattle herd on the reservation is approximately 22,000 head. He based his conclusions on BIA statistics. Tr. 11903, 11905.

477. Mr. Merchant concluded that the livestock industry on the reservation could be expanded from a base of 25,000 head by

50 percent to 37,500 head and Mr. Carver concluded that the herd could be expanded by only 25 percent from a base of 22,000 head to 28,900 head. Wyoming Exhibit WRIR LC-4, United States Exhibit WRIR C-17, Tr. 374, 377, Tr. 11903, 11905.

478. Mr. Merchant concluded that a financial analysis of his projected herd increase would show it to be feasible. Tr. 373.

479. Dr. Carver concluded that a financial analysis of his projected herd increase would also prove to be feasible. Tr. 11953

480. Mr. Merchant concluded that his projected increase in herd size would result in an economically feasible livestock industry.

481. Dr. Carver testified that an economic analysis of increasing the herd would show that an increase would not be feasible. Tr. 11943-44.

482. Although not economically feasible, ranchers probably would continue with their livestock enterprise because of a devotion to the values associated with ranch life. Tr. 11952-53.

483. Mr. Merchant disagreed with Dr. Carver's conclusion that it is not economically feasible to expand the livestock industry on the reservation because Wyoming's analysis was unreasonable. Mr. Merchant's economic analysis is justified and Mr. Carver's analysis was unreasonably conservative in the following respects:

a. The discount rate used by Dr. Carver in his economic analysis, 7 1/8 percent, is too high, a lower interest rate would decrease the costs of the livestock operation. The appropriate interest rate used by Dr. Carver should have been no more than 4 percent. Tr. 5049, 11950, 12083-84, 15517-18.

b. Dr. Carver limited the herd size per ranch to 250 animal units based on current tribal regulations, doing so he lost the advantage of some economics of scale. Tr. 12068, United States Exhibit WRIR RC-2, p. 27.

c. Dr. Carver assumed that the use of cross-breeding to increase selling weights, a practice not now permitted on the reservation, would continue in effect. Tr. 12070-71.

d. Dr. Carver limited potential returns by assuming that calves would not be held through the winter and be sold as yearlings. Tr. 12073.

e. Dr. Carver did not treat the opportunity cost of using otherwise unemployed labor as zero. Tr. 11987-88.

f. Dr. Carver did not treat the opportunity cost of using otherwise unproductive land as zero. Tr. 11990-93.

g. Dr. Carver used cattle prices that were lower than representative long term prices. Tr. 12101-05.

484. Although there is a difference of approximately 3,000 head of cattle in Mr. Merchant's and Dr. Carver's estimates of the potential for expanding the livestock on the Wind River Reservation, Mr. Merchant's conclusion of 25,000 head is not unreasonable.

485. Mr. Merchant computed the current water requirements of the reservation cattle herd by multiplying 25,000 head times an average daily requirement of 15 gallons per animal. He also determined the number of stockponds on the reservation and calculated the evaporation losses that would occur to them. Mr. Merchant then calculated the water requirements for the herd if it were increased by 50 percent. The water requirements calculated by Mr. Merchant for a herd of 37,500 cattle are 630 acre feet per year for direct consumption by the animals plus 2,100 acre feet attributable to stockpond evaporation for a total of 2,730 acre feet per year. United States Exhibit WRIR C-17, Tr. 269-71, 374-95.

486. Dr. Carver also reviewed the potential for expanding the livestock industry on the reservation. He used 12 instead of 15 gallons for the daily consumption of each animal. He also concluded that game animals would consume 6 gallons per day. Dr. Carver determined that the reservation could ultimately support 28,900 cattle, 4,000 horses and 6,000 game animals, with an animal water requirement of 485 acre feet for direct consumption and 515 acre feet for stockpond evaporation loses, a total of 1,000 acre feet. Wyoming Exhibit LC-4, Tr. 11954-63, 11965-69.

487. The methods adopted by Mr. Merchant are reasonable for calculating the future livestock water requirements. The future water need for livestock on reservation trust lands determined to be consumptive use of 2,730 acre feet of water annually. (See Findings 485.)

Groundwater

488. An evaluation of groundwater resources underlying the Wind River Indian Reservation was conducted by Oliver Page, an expert for the United States in hydrogeology and groundwater development. United States Exhibit WRIR C-31, Tr. 750-53.

489. Mr. Page made a reconnaissance study of groundwater conditions on the reservation for the purpose of determining water sources for mineral and other resource development on the reservation. Tr. 756-57, 984-86.

490. The reconnaissance study included review of published and unpublished sources of data compiled by the United States Geological Survey, the State of Wyoming and private companies. All of these sources are ordinarily relied upon by professionals in the field of hydrogeology and groundwater development. Tr. 753-54, 757.

491. To determine the presence and extent of groundwater on the Wind River Reservation, Mr. Page identified the geology of the reservation and the potential major water yielding formations. United States Exhibit WRIR C-31A (Table 1), United States Exhibit WRIR C-32 (generalized columnar section showing rock formations of reservation), United States Exhibit WRIR C-33 (geologic map of Wind River Indian Reservation prepared by United States Geological Survey), Tr. 754, 758-64.

492. The reservation's geology includes Quaternary deposits, that is, unconsolidated surface deposits consisting of alluvium--the sands and gravels and clays of the major streams and rivers--terrace, glacial and landslide deposits. Tr. 760-62.

493. Those Quaternary or surface deposits were studied individually by the government's expert, Mr. Page. Tr. 764-72, 791.

494. The Wind River Formation also was studied individually by Mr. Page. Tr. 772-73, 786-91.

495. Mr. Page studied as a group the later Tertiary or older formations shown on United States Exhibit WRIR C-32. That group includes the Fort Union and older formations. Tr. 791.

496. As part of his investigation Mr. Page made four trips to the Wind River Reservation, two were prolonged visits. He spent a total of approximately two weeks on the reservation. Tr. 982.

497. In that time he conducted three pump tests which were intended to measure pumping rates and groundwater levels. That information gives an indication of the characteristics of the aquifer which supplies a well. Two of the three pump tests yielded results, the third test did not and was considered to be a fluke. Tr. 757-58, 982-83.

498. Mr. Page conducted no seepage runs as part of his reconnaissance study. He concluded that seepage runs were unnecessary where groundwater supplies are generally in virgin condition as they are on the Wind River Reservation. His decision not to conduct the seepage run was reasonable. Tr. 912-13, 983-84, 997, 1004.

499. Groundwater may be considered to be in a virgin condition where it has not been developed and drawn down heavily. On the Wind River Reservation there is an abundant groundwater supply in virgin condition. Tr. 912-13, 921, 1008-14.

500. The safe yield, or perennial yield, may be defined as the quantity of water that can be drawn from a groundwater source over a long period of time without causing some adverse effect which could include depletion from storage, water level declines or intrusion of poor quality water. The concept of safe yield is used as a water management aid. Safe yield is not necessarily a limitation on groundwater development. Tr. 800.

501. Safe yield is ordinarily determined by observation of groundwater sources where withdrawals have placed stress on the water supply. It was reasonable for Mr. Page not to

determine the safe yield of groundwater sources on the Wind River Reservation because groundwater use is neither concentrated nor in significant quantities to make a realistic determination of safe yield. Tr. 802, 953-56.

502. Mr. Page determined that the amount of groundwater in storage in the Quaternary deposits comprising the saturated alluvium of the Wind River Reservation is approximately 360,000 acre feet. That determination is based on his study of the saturated thickness, area of the alluvium, and specific yields from the alluvium of the principal streams and creeks on the Wind River Reservation. The alluvium is comprised of unconsolidated gravel, sand, silt, clay, cobbles and boulders; it occurs in streams and valleys throughout the reservation. He concluded that the alluvium is essentially full of water under present conditions of water development on the reservation. Mr. Page qualified his estimate by stating that the 360,000 acre feet represented the total storage in the alluvium under full conditions, but that not all of that water was available for pumping from wells. Tr. 768-69, 922, 940-46, 968-69, United States Exhibit WRIR C-31A (Table 1).

503. The Quaternary alluvial deposits studied by Mr. Page include those of the Wind River, Little Wind River, Spring Creek, Mill Creek, Sage Creek, Owl Creek, Crow Creek,

Popo Agie River, Cottonwood Creek, Muddy Creek, Five Mile Creek, Kirby Draw, Beaver Creek. Tr. 969-974, United States Exhibit WRIR C-31A (Table 2).

504. The alluvial storage determinations by Mr. Page were made by calculating the product of the saturated thickness of the alluvium, the specific yield of the saturated materials and the adjusted area of the alluvial materials. This method is proper. Tr. 940-46, 1014-29.

505. Mr. Page testified that the Quaternary terracce deposits are scattered throughout the reservation. They consist of gravel, sand, silt, cobbles and boulders. Terrace deposits were laid down by streams when they were at a higher elevation, before the streams cut down into their present channels. The terrace deposits get some recharge from direct precipitation. However, quite often they are elevated above the streams and creeks so that they do not receive significant infiltration from surface flows. The principal source of water to them comes from infiltration of irrigation water; the terrace deposits for the most part are drained during the nonirrigation season. As a result of his investigation, Mr. Page concluded that the terrace deposits should not be considered a significant source of groundwater, principally because the terraces are dependent on overlying irrigation

development and resultant recharge from irrigation water in order to produce water. Tr. 771-72, 839-40, 946-49, United States Exhibit WRIR C-31A (Table 1).

506. Mr. Page concluded that the Quaternary glacial and landslide deposits were not significant to the groundwater supply of the reservation. He testified that the major glacial deposits are located at the foot of the Wind River mountains in the vicinity of Bull Lake and Dinwoody Lake. The glacial deposits consist of silt, sand, gravel, cobbles and boulders, unconsolidated till and outwash. Landslide deposits are made up of unconsolidated rubble, blocks and talus. Tr. 772, 842, United States Exhibit WRIR C-31A (Table 1).

507. The Wind River Formation is a Tertiary deposit consisting of interbedded sandstone, conglomerate, siltstone, claystone, and shale; it contains a small amount of bentonite, tuff, and limestone; red, gray, green, purple, white, tan, and brown. It exhibits a course-grained facies along the margin of the Wind River basin and grades into a fine-grained material toward the center of the basin. It ranges in thickness to approximately 5,000 feet. Outcrops of the Wind River Formation are present throughout the central portion of the Wind River Reservation. Tr. 772-73, 786-91, United States Exhibit WRIR C-31A (Table 1).

508. Some late Tertiary and older formations on the reservation have proven to be water bearing. Among them are the Madison, Fort Union and Bighorn Dolomite. Tr. 793, United States Exhibit WRIR C-31A (Table 1).

509. Mr. Page calculated the potential well yields from Quaternary deposits (alluvium, terraces, landslide and glacial deposits) and Tertiary desposits, including the Wind River Formation. United States Exhibit WRIR C-31A (Tables 1 and 2).

510. He concluded that the well yields from alluvial deposits range from a few to several hundred gallons per minute where deposits are thick and saturated. United States Exhibit WRIR C-31A (Table 1).

511. The principal source of water saturating the alluvium is surface water from streams flowing over the alluvial deposits. Other sources are irrigation return flows, precipitation falling directly on the alluvium and side flows into the alluvial deposits from other formations. Tr. 766-61, 770, 11849.

512. The surface water supplies water to the alluvium so that when water is pumped from a well in the alluvium, water is drawn from both the alluvium and the surface sources. Tr. 767, 879, 11860-63.

513. In presenting his estimates of the potential well yields from Quaternary deposits, Mr. Page was called upon to give his opinion of the margin of error or degree of reliability of his estimated well yields. Mr. Page testified that although it is not necessary to assign reasonable probabilities for the study he did, the probability of the accuracy of his his estimates was considerably better than 50 percent. Tr. 847, 868, 1030, United States Exhibit WRIR C-31A (Tables 1 and 2).

514. Some of the estimated well yields are based on Mr. Page's own calculations, others are conclusions drawn by the United States Geological Survey in Water Supply Papers 1576-I, 1519, 1375, and Hydrologic Investigation Atlas HA-270.

The estimates of potential well yields from Quaternary alluvial deposits that are the product of his research are as follows:

	Potential Yield gallons per minute
Wind River	20 to 900
Little Wind River	<100 to> 200
Mill Creek	up to 250
Sage Creek	80 to 190
Owl Creek	80
Crow Creek	25 to 80
Popo Agie River	20

The estimates of potential well yields that were derived by Mr. Page from the United States Geological Survey are as follows:

	Potential Yield gallons per minute
Cottonwood Creek	Few
Muddy Creek	Few
Fivemile Creek	Few
Kirby Draw	20 or less
Beaver Creek	20 or less

Tr. 852-55, 961-62, United States Exhibit WRIR C-31A (Tables 1 and 2).

515. The estimated well yields developed by Mr. Page required determination of the saturated thickness, the permeability, and the transmissivity of the alluvial deposit. His work in this regard was professional and the results obtained are reasonable and consistent with the practice of people in his profession. Tr. 856-70, 957-68, 976-80.

516. Mr. Page's reliance on United States Geological Survey data for the well yields for Cottonwood Creek, Muddy Creek, Fivemile Creek, Kirby Draw and Beaver Creek was reasonable and consistent with the practice of people in his profession. Tr. 871-78, United States Exhibit WRIR C-31A (Table 2).

517. Mr. Page determined the continuous pumping rates needed to meet peak annual water demand for potential

mineral developments on the Wind River Indian Reservation. Mr. Page determined the water sources to meet the peak annual demand as a result of his groundwater investigation on the reservation. Tr. 885.

518. Existing water uses account for peak annual demands identified by Mr. Page for oil (enhanced recovery), natural gas (refining) and sulfuric acid production. Tr. 1038-41, United States Exhibit WRIR C-31A (Table 4).

519. The sources and location of water for existing and potential mineral developments were developed by Mr. Page for mineral resources identified for him by witnesses for the United States employed by David M. Dornbusch and Company. Tr. 756, 809-19, 1038-44, United States Exhibit WRIR C-33B, United States Exhibit WRIR C-28.

520. Those mineral resources and corresponding water supplies are found to be reasonable and are identified on the following table:

Mineral	Activity	Location	Peak Annual Water Use (Acre-Feet)	Required Continuous Pumping Rate to Meet Peak Annual Water Demand (gpm)	Water Sources
Oil	Enhanced Recovery (Existing)	Multiple Locations	6,580	4,080	Wind River underflow and various sources

					of local deep groundwater including, but not limited to, the Madison formation, Big Horn dolomite and Frontier formation.
Natural Gas	Refining (Existing)	1S-6E (East of Riverton)	6	4	
	Sulfuric Acid Production (Existing)	1S-4E (Riverton Area)	95	60	Wind River formation and/ or municipal surface or groundwater (Wind River formation).
	Anhydrous Ammonia Production	1N-4E (Riverton (Area)	4,250	2,630	Wind River formation and/ or municipal surface or groundwater (Wind River formation).
Coal	Surface and Under-Ground Mining	6N-1E (Muddy Creek Area)	25	15	Shallow to Moderate depth groundwater in local sand-stone and conglomerate beds (Fort Union, Lance and Mesaverde formations).

Mineral	Activity	Location	Peak Annual Water Use (Acre-Feet)	Required Continuous Pumping Rate to Meet Peak Annual Water Demand (gpm)	Water Sources
	In Situ (Gasifi-cation and Syngas Production	2S-6E (Alkali Butte Area)	2,800	1,740	Wind River formation (off-site), or moderate depth groundwater in local sand-stone and conglomerate beds (Lance and Mesaverde formations) or deeper aquifers.
	Electri-city Generating Station	6N-1E (Muddy Creek Area)	2,490	1,540	Wind River underflow (off-site).
Uranium	Under-Ground Mining	7N-5W	15	9	Local shallow to moderate depth ground-water (Aycross and Wind River formations or equivalents).
	Yellow-Cake Processing	7N-5W	475	290	Wind River formation and/ or Crow Creek surface flow or underflow (off-site).
Phos-phate Rock	Under-Ground Mining	1S-2W	5	3	Little Wind River under-flow
	Benefi-cation and Calcining Plant	1N-4E (Riverton Area)	425	260	Wind River formation and/ or municipal surface or groundwater (Wind River formation).

	Phos-phoric Acid Production	1N-4E (Riverton Area)	400	250	Wind River formation and/or municipal surface or groundwater (Wind River formation).

Mineral	Activity	Location	Peak Annual Water Use (Acre-Feet)	Required Continuous Pumping Rate to Meet Peak Annual Water Demand (gpm)	Water Sources
Gypsum	Surface Mining	7N-1E to 3W	10	6	Local shallow to moderate depth groundwater (Chugwater Group and Park City/Phosphoria formation).
	Wall-board Production	1N-4E (Riverton Area)	300	190	Wind River formation and/or municipal surface or groundwater (Wind River formation).

United States Exhibit WRIR C-31A (Table 4).

521. Water requirements for municipal, domestic and commercial uses were identified by David M. Dornbusch and Company. Mr. Page reviewed the existing and future need for water for those purposes. He concluded that the expected increases in water requirements would not be significant as long as there were live

streams recharging the groundwater sources involved. Tr. 804-807, 1031, United States Exhibit WRIR C-33A, United States Exhibit WRIR C-19.

522. The Tertiary formations identified as occurring on the reservation also extend beyond the reservation boundaries. To the extent that any one of those formations is water bearing, its development probably would not have a widespread effect on water supplies elsewhere in the formation. This is so because of the development of the aquifers is relatively small, the aquifers are deep, points of recharge occur at a number of places, and in some formations such as the Wind River Formation, movement of water is restricted by fine grained sequences interspersed among coarser-grained facies. Tr. 786-91, 934-37.

523. Yields from principal Tertiary formations and their general quality were determined by Mr. Page through his own analysis and through information provided by the United States Geological Survey. Mr. Page reasonably concluded that at the level of study he performed it was not necesary to determine whether the quality of the groundwater from the different formations was suitable to a particular use. Tr. 988-89.

524. Essentially all of the late Tertiary and older formation studies by Mr. Page may contain water of sufficient and

recoverable quantity and quality. United States Exhibit WRIR C-31A (Table 1), United Exhibit WRIR C-32, Tr. 797-98, 808, 813, 819-20.

525. Robert Brogden testified for the State of Wyoming as an expert in groundwater geology.

526. Mr. Brogden's responsibilities in this case were limited to acquiring a general understanding of groundwater resources on the Wind River Indian Reservation. Tr. 11839-57.

XI. MINERAL DEVELOPMENT

527. James P. Merchant, of David M. Dornbusch & Co., Inc., qualified by the United States as an economist, testified on present and future mineral development on the Wind River Indian Reservation. Mr. Merchant studied the available information concerning mineral resources on the reservation, investigated the characteristics of mining and processing industries associated with minerals, and identified and evaluated trends in mining and processing industries. He did not utilize the more speculative cost-returns analysis method. Through his research the United State's expert determined that it is economic to develop the following minerals on the reservation presently or in the future: oil, natural gas, coal, uranium, phosphate rock and gypsum. United States Exhibits WRIR C-28, WRIR C-29 and WRIR C-33B. Tr. 943, 230, 486, 487, 707.

528. In the professional opinion of Oliver Page, a hydrogeologist qualified as an expert by the United States, there is sufficient groundwater, plus subsurface underflow or surface flow available to develop all of the minerals on the Wind River Reservation as identified by Mr. Merchant. The source and location of the water for mineral development is identified on United States Exhibit WRIR C-31A, Table 4. Tr. 751, 923.

529. Gary Watts, the State's witness, reviewed the United States' and the Tribes' Statement of Claims and Mr. Merchant's testimony. He testified that in his opinion there are some mineral deposits on the reservation, but the existence of these deposits does not necessarily mean that it is economically feasible to develop them now or in the future. Mr. Watts admitted that he has not conducted any independent feasibility study regarding future development of these or any other minerals on the reservation, or any analysis of the water requirements to which Mr. Merchant and Mr. Page testified. Furthermore, Mr. Watts did not present any evidence supporting his claim that there are substitutes available that will render these minerals useless or obsolete. Tr. 1151, 11555-556, 11590, 11590-593.

A. Oil

530. Currently there is considerable oil production on the Wind River Indian Reservation. Steamboat Butte, Winkelman Dome, and Lander oil fields are the only three fields that are under secondary recovery operations at the present time. United States Exhibit WRIR C-22. Tr. 494, 11571.

531. Both Mr. Merchant and Mr. Page, the United States expert economist and hydrologist, testified that 6,580 acre feet of water per year presently are required for secondary recovery

operations at these three sites. For Steamboat Butte, 1,030 acre feet per year are diverted from the Wind River, and the remainder used is groundwater. Mr. Page testified that water is produced in conjunction with secondary recovery operations at Steamboat Butte and that produced water is reinjected into the oil wells. There is no discharge. United States Exhibit WRIR C-31A, Table 4. Tr. 513-14, 814, 919.

Mr. Watts, the State's witness, testified that 94 acre feet per year are taken out of permitted ground wells, and nine or ten times that much water is being used from the produced water from the oil wells. Mr. Watts claimed that water is not being drawn from the Madison or other formations. Tr. 11572-573.

532. Mr. Page testified on groundwater sources for oil development at Winkelman Dome and Pilot Butte. He concluded that at Windelman Dome water is produced in conjunction with secondary recovery operations. Some of the produced water is reinjected into oil wells, some is released to the ground, and some is used for irrigation. Water from the Madison formation is also used. He found that much of the water used for secondary recovery operations at the Lander field comes from the Madison formation. United States Exhibit WRIR C-31A, Table 4. Tr. 813, 919.

533. The State's witness, Mr. Watts, testified that 3,900 acre feet per year are being drawn from ground wells, permitted by the State of Wyoming, at the Winkelman Dome and Lander fields. He also stated that, in his opinion, each of the three fields produced more than enough water through secondary recovery operations to meet their needs, and the water used from permitted ground wells is superfluous. Tr. 11574-575, 11573-576.

534. Both the United States's and the State's witness stated, on direct examination, that there is not sufficient basis to make a water claim for future oil development needs. On cross-examination, however, Mr. Merchant admitted that the prospect of substantially higher oil prices in future years may increase the amount of recoverable reserves because (1) higher prices would allow recovery of oil that was not profitable to recover before, and (2) higher prices will elicit more exploration for oil reserves. Greater recoverable reserves would increase the likelihood of increased development. Mr. Watts admitted he had not investigated recent acquisitions of oil and gas leases on the reservation, and was not even aware of the procedure for obtaining exploration and development rights on the reservation. He also testified that he was aware of oil companies' recent interest in development in the Overthrust Belt, and that this may lead to increased oil development on the reservation in the next several years. Tr. 11599-600, 615.

535. There are 6,580 acre feet per year of water presently are required for secondary recovery operations at Steamboat Butte, Winkelman Dome and Lander oil fields on the Wind River Indian Reservation. This water is collected from water produced from the oil wells in conjunction with secondary recovery operations, water drawn from the Madison formation and other deep groundwater sources, and, at the Steamboat Butte field, water from the Wind River.

536. Since it is reasonable to expect that there will be future oil development on the reservation, particularly in view of the prospect of substantially higher oil prices in future years and the commensurate increase in recoverable reserves, the use of 6,580 acre feet annually should not be restricted to existing secondary oil recovery operations. Instead that amount should be available to the Tribes so long as it is needed for secondary oil oil recovery.

B. Natural Gas

537. Mr. Merchant, the United States's expert economist, studied present and future development of natural gas on the Wind River Indian Reservation by investigating the location and production of existing gas fields on the reservation, those water uses associated with natural gas production, and the possibility of using natural gas for production of anhydrous ammonia in the future.

538. Through Mr. Merchant's testimony and the United State's exhibits, it was shown that currently there are several natural gas fields under production on the reservation. The major fields are the Pavillion, Pilot Butte, and Riverton East fields. There are three processing areas in the Riverton East field, and a natural gas sweetening and dehydrating plant in East Riverton is used to process natural gas reserves in the East Riverton field. A sulphuric acid plant is located southwest of Riverton. United States Exhibit WRIR C-23. Tr. 517-19.

539. Mr. Watts, the State's witness, testified that the sulphuric acid plant on the reservation uses only small amounts of natural gas does not use any sulphur derived from reservation fields. However, Mr. Watts admitted that the manager of the sulphuric acid plant, Mr. Watts' source for that information, did not tell him that sulphur and natural gas from the reservation could not be used in that plant. Tr. 11596.

540. Mr. Merchant testified that the natural gas sweetening and dehydrating plant presently requires 6 acre feet of water per year, and the sulphuric acid plant requires 95 acre feet per year. This water is derived from groundwater sources in the Wind River formation. Mr. Watts, the State's expert economist, did not evaluate or contradict these findings. United States Exhibit WRIR C-31A, Table 4. Tr. 517, 519, 520, 11591, 11677-678.

541. The United State's expert, Mr. Merchant, also concluded that it would be economically feasible for an anhydrous ammonia plant to be developed in the future on the reservation, possibly near Riverton. In reaching this conclusion, Mr. Merchant looked at long-term trends and the probable market area for production of nitrogen fertilizers. He also found that the natural gas production on the reservation exceeds the requirements of such a plant. Tr. 520-22, 529.

The plant envisioned by Mr. Merchant would produce 1,000 tons per day. This size plant, which is the smallest size at which economies of scale normally are achieved, was chosen partially on the basis of the availability of natural gas. Tr. 527-28.

542. Mr. Merchant concluded, on the basis of a conversation with the chief chemist at an ammonia plant in California (Tr. 526-27), that the proposed anhydrous ammonia plant would require 4,250 acre feet of water per year. The source of water for the plant would be surface or groundwater from the Wind River formation. United States Exhibit WRIR C-31A, Table 4. Tr. 519.

543. The State's witness, Mr. Watts, testified that the development of an anhydrous ammonia plant was a very speculative prospect. Mr. Watts claimed that the feasibility analysis for the plant must look at the lost opportunity costs resulting from

diverting natural gas from current uses to use for the ammonia plant. Mr. Watts did not conduct any such feasibility study, however, and he would not say that such a plant would never be built on the reservation. Tr. 11578-580.

544. As to future production levels of natural gas, Mr. Merchant testified on cross-examination that the price of natural gas probably will substantially increase after prices are deregulated as required under existing law. The increase in prices could well increase the amount of recoverable natural gas reserves, and result in increased production, in much the same way as for oil. Tr. 613-16.

545. There are several natural gas fields under production on the Wind River Reservation, specifically those identified on United States Exhibit WRIR C-23. There is a natural gas sweetening and dehydrating plant located east of Riverton, and a sulphuric acid plant southwest of Riverton. The processing plant requires 6 acre feet per year for processing natural gas, and the sulphuric acid plant requires 95 acre feet per year for its operations. The source of this water is groundwater from the Wind River formation.

546. It is technically and economically feasible that an anhydrous ammonia plant be located on the reservation in the next 40 years, and that plant would require 4,250 acre feet per year of water, to be derived from the Wind River formation.

547. There is substantial probability that recoverable natural gas reserves will increase as prices increase in the future, and that natural gas production may increase commensurate with increased demand. There must therefore be reserved to the Tribes an amount of water sufficient to develop these natural gas resources.

C. Coal

548. Mr. Merchant identified coal deposits on the reservation, described the deposits that in his opinion are suitable for development, and outlined the water requirements and water sources for development of these deposits.

Based on a United States Bureau of Mines report and a United States Geological Survey report, among other things, Mr. Merchant concluded that there are coal deposits in the Alkali Butte field in the southeast corner of the reservation, in the Muddy Creek area in the northern part of the reservation, near the surface in the Hudson area, and deep deposits between two locations as indicated on United States Exhibit WRIR C-24. There have been small mining operations in the Hudson area. Mr. Merchant concluded that the coal deposits at the Alkali Butte and Muddy Creek locations are suitable for development. Tr. 547-48, 550-52.

549. Mr. Merchant found that the coal reserves at Alkali Butte are suitable for development through underground

coal gasification. In reaching this conclusion, Mr. Merchant looked at both the technical and economic feasibility. He found that the coals in that location, which are of subbituminous rank, are at least 5 feet thick and are overlaid by sufficient overburden to be suitable for this process. By looking at industry trends, the grade of available coal, and market projections, Mr. Merchant concluded that in situ gasification would be economically feasible. The source of Mr. Merchant's information on the gasification process was primarily the four or five most recent "Symposium on Underground Coal Gasification", a collection of articles by professionals. Tr. 553, 717.

550. The State's witness, Mr. Watts, while admitting that he is not an expert on coal gasification, had certain reservations about the possible development of a plant. He claimed that, because of the possibility of serious groundwater contamination, and the location of the Alkali Butte coal field at the reservation border, mutual cooperation will be needed between Indians and non-Indians in developing such a plant. He did not find that such cooperation was impossible or even unlikely. Mr. Watts also testified, on the basis of studies relating to moisture content of coal, that no additional water would be required for coal gasification at Alkali Butte. However, Mr. Watts did not consider any other use for water for coal gasification other that the control of burning. Tr. 11583-587, 11583-595.

551. Mr. Merchant concluded that the in situ gasification process at Alkali Butte would require 2,800 acre feet per year of water. According to the United State's expert hydrologist, Mr. Page, the source of this water would be groundwater from the Wind River, Lance and Mesa Verde formations. United States Exhibit WRIR C-31A, Table 4. Tr. 554, 815-16.

552. The other location suitable for coal development, as determined by the United State's expert economist, is Muddy Creek. There the coal is shallower than at Alkali Butte, and is suitable for mining. The coal is sufficient to support a 150-megawatt power plant that could be added to interstate transmission lines. Tr. 553-54.

Twenty-five (25) acre feet per year of water would be required at Muddy Creek for dust control and surface reclamation, and 2,490 acre feet per year would be required for the power plant. The water for the mining operations would come from shallow (200 to 500 feet) wells, while the water for the power plant would be derived from the nearest major water source, that is, the Wind River underflow, and through wells such as at Pilot Butte. The water use for the in situ gasification and power plant would be totally consumptive. United States Exhibit WRIR C-31A. Tr. 560, 815-16.

553. According to the State's witness, Muddy Creek has 9,000,000 tons of recoverable coal reserves, and Alkali Butte

has 17,000,000 tons. Mr. Watts also concluded that the proposed power plant in the Muddy Creek field would consume 600,000 to 700,000 tons of coal annually, in other words, a 13 to 14 year supply of coal. In Watts' opinion, this is not a sufficient supply to justify construction of a power plant. Tr. 11580, 11581-582.

554. Mr. Merchant stated on cross-examination that the United States Geological Survey has identified many reserves on the reservation that are not identified on the United States Exhibit WRIR C-24, and that these may become feasible to exploit in the future. Furthermore, as with oil and gas, the price of coal is likely to increase in the future, thereby increasing the amount of recoverable coal reserves on the reservation. Tr. 616.

555. There are many coal deposits on the Wind River Reservation, as identified on United States Exhibit WRIR C-24. The coal deposits in the Muddy creek area and the Alkali Butte area are suitable for development. At Alkali Butte there are sufficient reserves, with a sufficient overburden, for in situ coal gasification. That process would require 2,800 acre feet of water per year, to be derived from groundwater and aquifers such as the Wind River, Fort Union, Lance and Mesa Verde formations.

556. At Muddy Creek, there are shallower coal deposits that are suitable for mining, and sufficient to suply a 150-megawatt power plant. Twenty-five (25) acre feet per year of water would be required for dust control and surface reclamation in connection with mining, and the proposed power plant would require 2,490 acre feet of water per year. The water for mining operations would be derived from shallow wells, and the water for the power plant would be brought to the area from the nearest major water source.

D. Gypsum

557. Mr. Merchant, the expert economist testifying on the United States' behalf, evaluated gypsum development possibilities on the Wind River Reservation by reviewing available information, including USGS and Bureau of Mines reports, on gypsum deposits. He looked at the location, size, grade of gypsum, the characteristics of the gypsum industry, and future industry trends. On the basis of that information, Mr. Merchant determined that the reservation contains massive deposits of high grade gypsum that could be surface mined. By analyzing data on and productivity and sales of wallboard, he concluded that in the future there will be an ample market for wallboard, which is produced using gypsum. Therefore he concluded that it would be feasible to mine the gypsum and use it in a wallboard manufacturing plant. Tr. 585-86, 586, 590, 588, 699.

Mr. Merchant estimated that the manufacturing plant would produce 400,000,000 square feet of one-half inch wallboard per year. The plant probably would be located near Riverton because of its proximity to rail service and the population needed for labor purposes. United States Exhibit WRIR C-27. Tr. 587-77.

558. Gary Watts, the State's expert, stated that in his opinion it is not economically feasible to develop gypsum on the reservation. The gypsum, he claimed, is found in steeply dipping beds, which normally must be removed through more expensive underground, not surface, mining techniques while there are large amounts of gypsum throughout the world that can be surface mined. He also stated that substitutes for gypsum may be developed in the future. Mr. Watts did not present any documentation or state any sources for these claims. Tr. 11558-559, 11562.

559. Surface reclamation in connection with mining gypsum on the reservation would require 10 acre feet of water per year from local groundwater. Based on a conversation with the plant engineer at a gypsum wallboard plant in Cody, Wyoming, Mr. Merchant concluded that the wallboard manufacturing plant would require 300 acre feet per year. Either surface water or groundwater could be used for the plant. Mr. Watts, the State's witness, did not review or contradict these water claims. United States Exhibit WRIC C-31A, Table 4. Tr. 587-88.

600. The gypsum deposits are located in the aesthetics area defined by the United State's experts, and the Tribes ultimately will have to choose between preserving this area and developing the gypsum. Tr. 592.

601. In Summary, there are massive gypsum deposits on the Wind River Reservation. It is technically and economically feasible to mine these deposits and to locate a wallboard manufacturing plant on the reservation. Gypsum mining would require 10 acre feet per year of surface water, and the wallboard manufacturing plant would require 300 acre feet per year of surface or groundwater.

E. Uranium

602. The United State's expert, Mr. Merchant, testified that there are indications of uranium deposits in the Aycross formation in the northwest corner of the reservation, with a quality of one-tenth of one percent uranium content. He concluded that, although the basic field work has not been done to positively locate these deposits, the increasing interest in uranium makes it likely that such field work will be carried out in the future. United States Exhibit WRIR C-25. Tr. 567-68.

603. To determine future development possibilites for uranium, Mr. Merchant analyzed the characteristics of other uranium mines in Wyoming, particularly the grade of uranium and

the size of the mines, and reviewed uranium industry trends. On the basis of those studies, he concluded that development of uranium deposits would be economically feasible.[18/] If deposits are found, they would be mined by underground mining, then the ore would be beneficiated or refined into yellowcake and shipped off the reservation for further processing. Tr. 568, 707-08.

604. Mr. Merchant determined that uranium mining activities would require 15 acre feet per year of water for dust control and incidental uses. He further concluded that, based on Cameron's Engineers Report on Mineral Industries in Wyoming, processing uranium into yellowcake would require 475 acre feet per year. The water would be drawn from local shallow to moderate depth groundwater, and from the Wind River formation or Crow Creek surface flow. United States Exhibit WRIR C-31A, Table 4. Tr. 568-69, 571.

605. The State did not offer any evidence on uranium development on the reservation.

18/ Mr. Merchant admitted that uranium prices have been volatile over the past several years, but stated that these fluctuations appeared to be based largely on political events. And although federal regulation of uranium may tend to raise development and production costs, the price of uranium also is likely to increase because of the increased future demand for energy. Tr. 712-16.

606. There are indications of uranium deposits on the reservation. The uranium, if it exists, is likely to be mined through undergound mining and processed into yellowcake on the reservation. Mining would consume 15 acre feet per year of water for dust control and incidental uses, and processing would require 475 acre feet of water per year. The water will be drawn from local shallow to moderate depth groundwater, the Wind River formation, or the Crow Creek surface flow.

F. Phosphate Rock

607. James Merchant also analyzed the possibility of future development of phosphate rock on the Wind River Reservation. He determined, by reviewing available information on phosphate deposits, that there are extensive phosphate deposits on the reservation. By analyzing the characteristics of the phosphate industry, trends in the production of phosphoric acid, and technological suitability of grades of phosphate rock for processing, the United States' expert concluded that there is increasing demand for phosphate in the United States and concluded that phosphate rock on the reservation could be mined, then shipped to a plant in the Riverton area for beneficiation and use in a wet acid processing plant. Mr. Merchant testified that, although the phosphate rock is of a fairly low grade, it is capable of beneficiation. United States Exhibit WRIR C-26. Tr. 573-74, 619-20.

608. Mr. Watts, the State's witness, stated that in his opinion it is not economically feasible to develop phosphate rock. He claimed that, as with coal and gypsum, the resource is in steeply dipping beds, and must be mined by the more expensive underground mining method while there is a great deal of phosphate rock throughout the country that can be mined by cheaper strip mining techniques. Furthermore, he claimed that substitutes obviating the need for phosphate rock may be developed in the future. Mr. Watts did not audit Mr. Merchant's figures or present any specific evidence to support his conclusion. Tr. 11558-559. Tr. 11561-570.

609. Mr. Merchant and Mr. Page concluded that phosphate rock mining would require 5 acre feet per year of water, which could be drawn locally from on-site wells near the mine. Beneficiation would consume 425 acre feet of water per year, and production of phosphoric acid would consume 400 acre feet of water per year. In the Riverton area this water could be drawn from the Wind River formation or from surface water. Mr. Watts did not review the United States expert's conclusions on water requirements and sources. United States Exhibit WRIR C-31A, Table 4, Tr. 574-75, 817, 818.

610. There are low grade phosphate rock deposits on the Wind River Reservation, including but not limited to those identified on United States Exhibit WRIR C-26. It is economically feasible to develop these minerals in the future by mining, beneficiation, and use in a wet acid processing plant. Mining will require five (5) acre feet per year of water, to be drawn from on-site wells. Beneficiation will consume 425 acre feet of water per year, and wet acid processing 400 acre feet per year of water, which will come from available wells, surface water, or, if near Riverton, the Wind River formation.

XII. MUNICIPAL

611. Mr. Merchant testified to the current and projected Indian populations on the reservation. The Indian population is defined as enrolled members of the Shoshone and Arapahoe Tribes and their immediate families. Tr. 402-04, United States Exhibit WRIR C-18.

612. The State of Wyoming through its attorney James Merrill conceded that the population projections of Mr. Merchant are accurate and did not offer evidence to contradict them. Tr. 11606, 11620.

613. Mr. Merchant's testimony regarding population is reasonably accurate and is found to be a reliable basis on which to project to the year 2020 municipal water requirements for the Indians on the Wind River Reservation.

614. The Indians residing in Riverton which, as stipulated by the State, United States and Tribes, is located within the reservation, are entitled to water for their projected needs. Mr. Fassett's contention that a dual water system will be needed to serve the Indians is unwarranted. Tr. 11619.

615. Mr. Merchant's reliance on existing daily per capita water use at Fort Washakie of 325 gallons is reliable. Mr. Fassett's proposed per capita allocation of 220 gallons is not provided with support sufficient to overcome Mr. Merchant's conclusion.

616. Mr. Merchant testified the following were the municipal water requirements for Indians on reservation. The testimony includes present and future needs projected through the years 2000 and 2020.

Source	Municipality	1980 (Annual	2000 requirements	2020 in acre feet)
Wind River	Riverton	18	27	39
Little Wind River	Fort Washakie	455	666	972
Little Wind River	Ethete	257	375	549
Popo Agie River	Boulder Flat	26	37	56
Groundwater	Riverton	18	27	39
Groundwater	Arapahoe	155	228	331
Groundwater	Pavillion	2	3	4
Groundwater	Other areas of reservation	110	161	236

United States Exhibit WRIR C-18, Tr. 404, 483-86.

617. The water requirements for Ethete, Boulder Flat, Arapahoe, Pavillion and other areas of the reservation were agreed to by the witness for Wyoming, Mr. Fassett. Tr. 11620-22.

618. Mr. Fassett accepted the per capita water requirements for the City of Riverton but disagreed that there was a need to make a reserved water right claim for Indians living in Riverton. Tr. 11619.

619. Mr. Fassett concluded that Mr. Merchant overestimated the daily per capita water requirement for Fort Washakie at 325 gallons. However, Mr. Merchant's figure is based on actual useage, Mr. Fassett's conclusion of 220 gallons per day was estimated and not confirmed in the field. Tr. 486, 11616-18.

XIII. FISHERY

The United States adopts, and hereby incorporates by reference, the findings of fact submitted by the tribes in this case in support of the claim that fishing was a purpose for creating the Wind River Reservation.

620. There are sixteen streams or portions of streams on the Wind River Indian Reservation which are of primary or potential importance for fisheries for the Shoshone and Arapahoe Indian Tribes. These streams are subject to impacts from existing and potential water development. Tr. 6361-63, 6366, 6654, United States Exhibit WRIR C-280, pp. 9, 21-87, United States Exhibit WRIR C-281.

621. In preparing its claims for fisheries, the United States reviewed a number of methods that have been developed to determine instream flow requirements for fisheries. Tr. 6343-45, 6572-6576.

622. Among those methods is the Cooperative Instream Flow Group (IFG) incremental methodology which was developed by U.S. Fish & Wildlife Service and which was used by the United States to prepare claims in this case. Tr. 6337-38, 6340-42, 6346, 6574-76, United States Exhibit WRIR C-280.

623. The IFG incremental methodology is designed to quantify potential fish habitat by species in a stream reach under various flow regimes. United States Exhibit WRIR C-289, p. 2.

624. The incremental methodology chosen by the United States is an accepted method for determining water needs for fish habitat. Tr. 6358-59, 6575-75, 15243-45.

625. The witness for the United States, David A. Vogel, applied the IFG incremental methodology in a scientific and professional manner according to the guidelines of the IFG. His field work included more than 60 days of on-site visits to the rivers and streams he studied and more than 3,000 measurements of stream characteristics relating to velocity, depth and substrate. Mr. Vogel analyzed the results of his field work with computer programs prepared by the IFG. United States Exhibit WRIR C-280, pp. 9-18, Tr. 6360-6553.

626. The hydrologic data required for use of the IFG incremental methodology was developed by Michael Keene of H.K.M. Associates, a witness for the United States, and provided to Mr. Vogel by Mr. Keene. Tr. 6478, 7136-41, 7148.

627. Instream flows recommended by Mr. Vogel to provide the optimum habitat for the fish species he considered are expressed in terms of mean monthly instantaneous flows. United States Exhibit WRIR C-280, pp. 19-20, Tr. 6491-92.

628. The average natural flows for the respective streams in the fishery claim are those which occur in a one in two year recurrence interval. H.K.M. calculated flows not only for the one in two years, but also one in five, and one in ten year low flow recurrence intervals. In terms of fishery resources, monthly flows occurring in a one in ten year low flow recurrence interval are considered to be severe conditions. United States Exhibit WRIR C-280, pp. 19-20, Tr. 6505, 6518-19.

629. Based on the evidence received at trial, the following non-consumptive instream flows are needed to maintain optimum habitat for fishery resources on the Wind River Indian Reservation. The flows are based on a one in two year low flow recurrence interval and are expressed as mean monthly instantaneous flows.

Reach 1 -- Wind River (above Dinwoody Creek)

	MMF (cfs)
January	173
February	172
March	176
April	258
May	320
June	320
July	320
August	320
September	320
October	320
November	246
December	199

Reach 2 -- Wind River (between Dinwoody and Bull Lake Creeks)

	MMF (cfs)
January	201
February	200
March	207
April	284
May	500
June	500
July	500
August	500
September	500
October	444
November	302
December	239

Reach 3 -- Wind River (between Bull Lake Creek and Diversion Dam)

	MMF (cfs)
January	254
February	249
March	258
April	371

May	500
June	500
July	500
August	500
September	500
October	500
November	365
December	291

Reach 4 -- Wind River (between Diversion Dam and Little Wind River confluence -- two study sites)

	MMF (cfs)
January	256
February	250
March	260
April	325
May	325
June	325
July	325
August	325
September	325
October	325
November	325
December	293

Reach 5 -- Wind River (below Little Wind River to boundary of Boysen Reservoir Withdrawal Area)

	MMF (cfs)
January	393
February	384
March	396
April	500
May	500
June	500
July	500
August	500
September	500
October	500
November	500
December	439

Reach 6 -- Wind River (Wind River Canyon)

	MMF (cfs)
January	399
February	390
March	444
April	500
May	500
June	500
July	500
August	500
September	500
October	500
November	500
December	444

Reach 7 -- East Fork Wind River (below Wiggins Fork)

	MMF (cfs)
January	45
February	43
March	45
April	95
May	207
June	207
July	207
August	207
September	123
October	82
November	56
December	49

Reach 8 -- Bull Lake Creek (above Bull Lake)

	MMF (cfs)
January	29
February	31
March	29
April	47
May	215
June	215
July	215
August	215
September	180
October	83
November	45
December	33

Reach 9 -- Bull Lake Creek (below Bull Lake)

	MMF (cfs)
January	30
February	33
March	31
April	50

Reach 9 Continued

	MMF (cfs)
May	255
June	255

July	255
August	255
September	178
October	76
November	41
December	32

Reach 10 -- North Fork Little Wind River (below North Fork Canyon)

	MMF (cfs)
January	19
February	20
March	20
April	26
May	80
June	80
July	80
August	80
September	69
October	35
November	23
December	20

Reach 11 -- South Fork Little Wind River (below Washakie Reservoir)

	MMF (cfs)
January	22
February	25
March	23
April	31
May	110
June	110
July	110
August	91
September	72
October	41
November	28
December	23

Reach 12 -- Little Wind River (above Popo Agie River confluence)

	MMF (cfs)
January	49
February	51
March	51
April	71
May	75
June	75
July	75

August	75
September	75
October	75
November	61
December	52

Reach 13 -- North Fork Popo Agie River (below North Fork Canyon)

	MMF (cfs)
January	17
February	16
March	15
April	26
May	77
June	77
July	77
August	77
September	52
October	34
November	23
December	19

Reach 14 -- Popo Agie River (below the North and Middle Forks and above Little Wind River confluence)

	MMF (cfs)
January	48

February	46
March	46
April	94
May	172
June	172
July	172
August	172
September	140

Reach 14 Continued	MMF (cfs)
October	91
November	63
December	53

Reach 15 -- Dinwoody Creek (below Dinwoody Lakes)

	MMF (cfs)
January	15
February	14
March	14
April	21
May	110
June	110
July	110
August	110
September	95

October	38
November	21
December	16

Reach 16 -- Crow Creek (above Crow Creek Canyon)

	MMF (cfs)
January	3
February	3
March	3
April	6
May	12
June	12
July	12

Reach 16 Continued	MMF (cfs)
August	12
September	7
October	5
November	4
December	3

VX. LAND STATUS

630. Ms. Mae M. Eckman, manager of the Land, Titles and Records Section of the Bureau of Indian Affairs in Billings, Montana presented testimony and official documentary evidence regarding land status and title information for the Wind River Indian Reservation. Tr. 7840-70, United States Exhibit WRIR C-317.

631. Additional official documentary evidence was introduced by the United States regarding the land title and status of lands around Boysen Reservoir, upon which certain lands claimed as irrigable by the United States exist. United States Exhibits WRIR C-318, WRIR C-319, Tr. 7862-7870.

632. All of the land that the United States claims to be "practicably irrigable acreage" is currently held in trust by the United States. United States Exhibit WRIR C-317.

633. All land except as described in Finding number was reserved as part of the Wind River Indian Reservation by the Treaty of July 3, 1868. United States Exhibit WRIR C-317.

634. Certain lands north of the stipulated boundaries of the Wind River Indian Reservation have been purchased, and are currently held, in trust by the United States. The United States claims water rights for the following lands indicated by the tract numbers associated therewith at trial. The date of purchase and, where appropriate, the state adjudicated water right date are shown.

ARAPAHOE RANCH
MERRILL LAND PURCHASE
LANDS NORTH OF SOUTH FORK OF OWL CREEK

Date of Purchase

July 14, 1948

TRACT #	DITCH NAME	PERMIT #	PROOF #	ACRES	PRIORITY DATE	U.S. EXHIBIT #
33-8C	Typer #4	11707	14032	64	05-16-1912	WRIR-129
33-9C	Riggs	6621	14024	27	06-20-1904	WRIR-129

TRACT #	DITCH NAME	PERMIT #	PROOF #	ACRES	PRIORITY DATE	U.S. EXHIBIT #
33-2	Typer 3#*	10719	N/A	9.4	8-21-1911	WRIR-134

PADLOCK RANCH PURCHASE
LANDS NORTH OF MAINSTEM OF OWL CREEK

Date of Purchase

April 10, 1941

TRACT #	DITCH NAME	PERMIT #	PROOF #	ACRES	PRIORITY DATE	U.S. EXHIBIT #
34-1C	Sliney & Mikkelson	Terr.	3226	122.63	10-1884	WRIR-132
34-2C	Sliney & Mikkelson	Terr.	3526	32.0	10-1884	WRIR-136
34-3C	Sliney & Mikkelson	Terr.	3527	222.63	10-1884	WRIR-132
34-4C	Padlock	Terr.	3534	224.35	06-1887	WRIR-136
34-5C	Dewitt	2306	6271	17.0	10-04-1899	WRIR-132
34-6C	Sliney No. 1	4038	8350	160.0	07-11-1902	WRIR-132
34-7C	Sliney No. 1	4038	8351	160.0	07-11-1902	WRIR-132
34-8C 1	Rothwell Enl. of Sliney No. 1	2125E	15024	85.0	09-17-1909	WRIR-132
34-8c 2	Rothwell Enl. of Sliney No. 1	2125E	15024	233.0	09-17-1909	WRIR-132

PADLOCK RANCH PURCHASE
LANDS NORTH OF MAINSTEM OF OWL CREEK

Date of Purchase

April 10, 1941

TRACT #	DITCH NAME	PERMIT #	PROOF #	ACRES	PRIORITY DATE	U.S. EXHIBIT #
34-9C	Padlock	Terr.	3533	252.0	06-1887	WRIR-132
34-10C	Padlock	Terr.	3534	41.0	06-1887	WRIR-132
34-11C	Padlock	Terr.	3534	284.44	06-1887	WRIR-135

TRACT #	DITCH NAME	PERMIT #	PROOF #	ACRES	PRIORITY DATE	U.S. EXHIBIT #
34-1	Padlock	N/A	N/A	24.0	N/A	WRIR-132
34-2	Sliney #1	N/A	N/A	12.0	N/A	WRIR-132
34-4	Padlock	N/A	N/A	5.0	N/A	WRIR-135

TRACT #	DITCH NAME	PERMIT #	PROOF #	ACRES	PRIORITY DATE	U.S. EXHIBIT #
34-1X	Padlock	N/A	N/A	43.1	N/A	WRIR-132
34-5X	Sliney No. 1	N/A	N/A	44.0	N/A	WRIR-132

XV. WYOMING SYSTEM OPERATION

635. State of Wyoming consultants Mr. Leonard Rice and Mr. Gordon Fassett testified regarding the development of, and results achieved by, a computer model developed in an attempt to see what adverse effect the United States claims for water rights might have on persons exercising State water rights.

636. The model developed by the State's consultants was not limited to the area of the reservation, but was designed to compute water supply and demand through out the Big Horn basin. It was thus not designed to rebut or challenge the results of Mr. Keene's natural flow analysis or Mr. Billstein's systems operation study. Tr. 9504. However, the State of Wyoming stated "for the record" that it has no quarrel with the results of those studies and feels that Mr. Billstein did a good job. Tr. 10031.[19/]

637. The State's consultant's apparently did a depletion analysis similar to that of Mr. Toedter and a natural or virgin flow analysis similar to that done by Mr. Keene. The work on behalf of the State was done by Mr. Doug Torza who did not testify. Tr. 9376. The State's depletion and virgin flow analysis were input to the computer program and technically not part of the program itself. No criticism was offered of either Mr. Toedter or Mr. Keene's results.

19/ The transcript indicates that this statement was made by Mr. Clear but it was, in fact, made by Mr. White, counsel for the State of Wyoming.

638. Mr. Fassett testified that, in conjunction with the depletion analysis inherent in the program, several cropping patterns were developed. There were two cropping patterns for each of the four counties in the basin, one for altitudes above 6,000 feet in elevation and one for altitudes below that elevation. Tr. 10114. The State's consultants developed a cropping pattern for each of the years in the 1970-79 period and for a "long term" average year. Tr. 10451. This results in eighty-eight different cropping patterns, since each county was assigned its distinct cropping pattern and each county was divided at the 6,000 foot level. Mr. Fassett testified that Mr. Jim Jacobs told him to divide the patterns at 6,000 feet. Tr. 10114. Mr. Bishop later testified that Mr. Jacobs told him that the correct elevation division line was 5,500 feet.

639. The Wyoming model was limited to a base of a ten year period, 1970-79. Tr. 9376. Mr. Charles Rehr, another witness called by the State, testified that this was too short a base period to determine hydrologic potential. Tr. 12544.

640. The State's consultants did not include all the outstanding State adjudicated and permitted water rights in the model's data base. Some water rights were excluded on the advice of Mr. Christopolous and others excluded by Mr. Fassett. Tr. 9544-45. Only 80 percent of the acres covered by the certificated rights were included (Tr. 9544) and only 65 percent of the permitted acres were included. Tr. 9547.

641. The State water rights that were included in the Wyoming model were not assigned a full diversion requirement. Under State law a person with a State water right can divert 1 C.F.S. per 70 acres, or about 4.3 acre feet per acre per irrigation season. Tr. 9835-36. In some cases Wyomings model the allows only 3.25 acre feet per acre of diversion (Tr. 10295), in others 2.52 acre feet (Tr. 10326-7), and in others 3.5 acre feet per acre. Tr. 9836. In some cases the State used the actual diversion records, such as at Midvale (Tr. 10319-21). Where actual records were used, the unit diversion requirements were much greater than the 3.25 acre feet per acre or the 3.5 acre feet per acre normally assigned by the State's consultants in the model.

642. The diversion requirements used in the model are strickingly smaller than those testified to at the Worland hearings where the farmers unanimously testified that they used more than 1 c.f.s. per 70 acres per year.

643. The effect of these cutbacks in the actual water use and in the outstanding State permits and certificates is to reduce the conflicts among non-Indian water. The ultimate results of the model, which allegedly show that the Indian water rights will conflict with a particular non-Indian water right, are therefore unreliable.

644. While the model was purportedly "verified" to see if the result met the "real world situation" (Tr. 9565-69), on cross-examination the State of Wyoming stipulated that at no place in the basin could the model be verified for any month during the irrigation season. Tr. 10286. The State model, however, reaches conclusions on water availability on a month by month basis. Tr. 10229.

645. The model developed results based on a statistically dry year based upon only two gauging stations in the basin. At one station, Bull Lake Creek near Lenore, the statistical dry year had less flow than the driest year in the corresponding period of record. Tr. 10173. The period of record for this gaging station is 1919-1979. Tr. 10172. The statistical dry year is, therefore not reliable.

646. The computer printouts were reported on a calender year basis, that is January through December. The virgin flow results were into the computer data base on a water year basis (September through August). As a result the computer output compares diversions for a particular month in one year with the virgin flows of the same month in the previous year. Tr. 10185-91. Since the model operates sequentially, streamflows which are out of order impacts the results of the analysis. Tr. 10189-91.

647. The assumptions used by the State to depict the current level of development in the basin for the purposes of model verification is totally suspect. For the Little Wind River watershed shown on WRIR MF-14-5, the SCS 1969 study showed 34,700 acres presently irrigated. Using standard of 1 cfs per 70 acres for the State awarded water rights on WRIR MF-14-5, Mr. Fassett operated this reach of the model to serve only 5696.6 acres. Tr. 10210-12, 10215-16. Results of this operation was utilized in the verification of the model at Fassett Station No. 26. Tr. 10196, 10198.

648. Mr. Fassett testified that his model was run under strict administration. He admitted that this was not the current situation in the basin. Yet the strict administration assumption was used in model verification assessments. This casts doubt on the results. Tr. 10225.

649. Releases at Boysen Reservoir further illustrate the major difference between the 'real world' situation and the Fassett Model. Tr. 10247-48, 10253-54, 10263. This is confirmed by comparing the Fassett Model flows below Boysen with official U.S.G.S. records. Tr. 10285.

650. Mr. Fassett did not include the North Fork Chute in his operational analysis of the Little Wind River Basin. He admitted that he knows the facility was used but omitted it because it had no state water right. Yet his model purports to show the "real world" situation. Tr. 10313.

651. Fassett Diversion schedules rather than actual BIA administered FIP records were used relative to lands served within the Wind River Federal Irrigation Project. Tr. 10315-16.

652. There were many differences between historic diversion records for selected canals within the basin and Mr. Fassett's diversion schedule. Tr. 10329-63.

653. The actual computer program was developed and written by Mr. Paul Musser, who did not testify. Tr. 9470. Mr. Musser developed the logic flow diagram for the program. Tr. 9471. Neither Mr. Rice nor Mr. Fassett can read the computer program or explain the logic diagram. Tr. 9474, 10088. Miss Carla Worly was apparently responsible for running the computer and see that it was properly operated. Tr. 9378-79. She was not called as a witness.

654. Mr. Fassett testified that he had developed the logic program for the computer. He had never done this before. Tr. 10082-83. The computer program used by the State in this case has never been used before and is not "time-tested". Tr. 9473.

655. On cross-examination Mr. Fassett admitted that Dinwoody Canal, which carries about 30-40,000 acre feet of water was omitted from his virgin flow analysis at Gauge No. 2 on the Wind River. This resulted in an underestimation of natural flow on the Wind River with the corresponding result that more state rights would be called out of priority. Tr. 10148-57. Mr. Fassett reworked

his model and, on redirect, testified that he had now included the virgin flows for Dinwoody Creek. Tr. 10454-58. Mr. Fassett testified that, as a result, more State water rights would be called out by the United States claim. Tr. 10458. This is an incredible result since an increase in virgin flow increases supply, not diversion.

656. The operational studies should not have been conducted with both the Tribe and United States claims lumped together. Each claim should have been individually analyzed. Tr. 10368, 10370.

657. The computer program had to assume that some of the outstanding State certificates or State permits allowing water diversions would ultimately be validated in these proceedings. Mr. Christopolous, the State Engineer, testified that he had supplied Mr. Fassett with a list of "valid" certificates and permits, but that the Court should not and could not rely on that list for its determination of the validity of the State permits and certificates. The data base used by Mr. Fassett is therefore legally incompetent evidence.

PROPOSED CONCLUSIONS OF LAW

1. The boundaries of the Wind River Indian Reservation are as agreed by the parties in the "Stipulation Concerning the Boundaries of the Wind River Indian Reservation" filed with the Court in this case.

2. At the creation of the Wind River Reservation by the Treaty of Fort Bridger on July 3, 1868, a reserved water right vested, in a quantity to meet the present and future needs of the Wind River Indian Reservation and to provide a permanent home for the Indians there. The reserved right extends to the surface and groundwater resource of the Wind River Indian Reservation. This includes the right to use the most accessible and least expensive water source. The priority date for that reserved right is July 3, 1868.

3. The reserved water right of the Wind River Reservation is that amount of water required for the development for beneficial use of the human and natural resources on the reservation. Development of those resources will assure the existence of the reservation as a permanent tribal homeland.

4. The proper measurement of the reserved water right is that quantity of water which is necessary to make the Wind River Indian Reservation a permanent homeland for the Shoshone and Arapahoe Indians. The right includes that amount of water sufficient to serve the needs of all of the practicably irrigable acreage, livestock operation, mineral development and associated industrial activities, municipal, commercial and

domestic purposes, instream flows for preservation of optimum fish habitat, and to preserve aesthetic and wildlife areas.

5. The admission of Wyoming into the Union by the Act of July 10, 1890, (26 Stat. 222) did not affect the preexisting reserved water rights of the Wind River Reservation in any way.

6. The Tribes are entitled to a reserved water right for those lands outside of the stipulated boundaries of the Wind River Indian Reservation known as Arapahoe Ranch and Padlock Ranch and described in Article IV of the decree, that have been purchased and are held in trust by the United States for the Shoshone and Arapahoe Indians. The priority to water for those lands is the dates on which the lands were purchased, April 10, 1941, and July 14, 1948. The Tribes also are entitled to the state awarded water rights and priority dates appurtenant to the those lands which are set forth in Article IV of the decree.

7. Wyoming's constitution, which was accepted, ratified and confirmed by Congress upon Wyoming's admission to the Union, did not affect the preexisting reserved water rights of the Wind River Reservation in any way. Indeed, Wyoming's constitution expressly disclaims "all right and title . . . to all lands owned or held by any Indians or

Indian tribes . . . and that said Indian lands shall remain under the absolute jurisdiction and control of the Congress of the United States . . . ." As has already been concluded, Indian reservation lands have as an incident of title a reserved right to water to fulfill the purposes of the reservation. Wyoming's constitutional disclaimer underscores the immunity from state jurisdiction enjoyed by all Indian reservations in the United States except as that immunity has been specifically modified by Congress.

8. The Act of March 3, 1905, (33 Stat. 1016) opening a portion of the reservation to settlement did not affect the reserved rights of the Wind River Reservation. Article X of the 1905 Act expressly provides that nothing in it "shall be construed to deprive the . . . Indians . . . of any benefits to which they are entitled under existing treaties or agreements, not inconsistent with the provisions of this agreement." Article III of the 1905 Act provides that the United States will perform such acts as

> are required by the statutes of the State of Wyoming in securing water rights from said State for the irrigation of such lands as shall remain the property of said Indians, whether located within the territory intended to be ceded by this agreement or within the diminished reserve.

The latter provision did not abrogate the reserved water rights of the reservation created by the Treaty of Fort Bridger in 1868 and protected by Article X of the 1905 Act.[20/]

20/ This conclusion is not disputed by the State of Wyoming:

> "Wyoming admits that the priority date for any reserved water right found by the Court to exist for those portions of the Wind River Reservation which were never disestablished or patented to non-Indians is July 3, 1868." Wyoming's Brief in Support to its Response to the claims for Water Rights of the United States and the Shoshone and Arapahoe Tribes 52.

If Article III has no effect on reserved water rights on the unopened reservation, then logic compels that Article III has no different effect on the opened reservation. In fact, there was no difference in the United States position with respect to implementing Article III on the opened and unopened

9. The opening of the reservation by the 1905 Act did not make the opened lands public lands. They remained Indian lands. Article IX of the 1905 Act expressly provides that the United States was to act as trustee of the lands and oversee their disposal for the benefit of the Indians. The 1905 Act itself did not affect the Indians' interest in the opened lands. While the lands remained undisposed of the Indians continued to enjoy the full beneficial interest in them subject only to the possibility of their being sold, at which time the Indians would become the beneficiaries of the proceeds. Prior to the 1905 Act the Tribes possessed both sovereign and proprietary interest in those lands. After the 1905 Act they retained their sovereign interest only until the lands were reacquired in trust at which time the Tribes' proprietary interest was reunited with the land. As stipulated by the parties, the reservation includes all lands, whether Indian or non-Indian owned, within the exterior boundaries of the reservation.

10. All tribal and allotted lands held in trust by the United States on the Wind River Indian Reservation whether or not located in the opened portion of the reservation, have a reserved water right with a priority of July 3, 1868, when the reservation was established by the Treaty of Fort Bridger.

11. All lands that have been sold out of Indian ownership but have been reacquired and are presently held in trust by the United States for the Tribes or members of the Tribes of the Wind River Indian Reservation have a reserved water right with a priority of the date of the reservation. Any water rights acquired pursuant to state law and conveyed in the reacquisition remain in effect.

IN THE DISTRICT COURT OF THE

FIFTH JUDICIAL DISTRICT

STATE OF WYOMING

IN RE: THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING	)	CIVIL NO. 4993

BRIEF IN SUPPORT OF THE UNITED STATES' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW

What has been perhaps the longest Indian water rights trial in history has come to a close. The quantification trial extended from January 26, 1981 to February 19, 1982. Another week of trial regarding the reservation dates occurred in July 1980. A massive record has been compiled, consisting of over 15,500 pages of trial transcript and thousands of pages of exhibits and maps. The record addresses the testimony of the 42 separate expert witnesses, not to mention the numerous lay witnesses, that testified regarding the measurement of the quantity of water reserved for the Indians of the Wind River Reservation.

The attorneys and experts for the United States have reviewed the massive and complex record to propose findings of

fact and conclusions of law and supporting arguments regarding the proper quantity of water that was reserved for the Indians. The first part of this brief sets forth a review of the applicable law that should guide the Special Master in his decision and addresses certain questions regarding the law that have been raised by the State of Wyoming in the past. The second part of the brief contains the arguments regarding the evidence on the various claims asserted by the United States.

I. FEDERAL RESERVED WATER RIGHTS

The reserved water rights doctrine has evolved in Supreme Court precedent over a period of 70 years and should be the exclusive guide in the Special Master's determination of the reserved water rights for the Wind River Indian Reservation. In Winters v. United States, 207 U.S. 546 (1908), the Supreme Court for the first time explicitly recognized federal reserved water rights. In Winters, although the treaty setting apart certain lands for an Indian reservation did not contain an express reservation of a right to the use of water on such reservation, the Court relied upon the implied intent of Congress in the Fort Belknap Agreement

to transform the Indians from a nomadic into a "pastoral and civilized people", to declare the need for irrigation water to make the reservation lands productive, and to find undeniably that:

> The power of the Government to reserve waters and exempt them from appropriation under state laws is not denied, and could not be. Id. at 577.

When public lands are withdrawn or reserved for authorized purposes requiring the use of water, the right to use a sufficient amount of the unappropriated waters pertaining thereto to accomplish those purposes is also reserved and, consequently, ". . . exempt[ed] . . . from appropriation under state law". Winters, supra.

The Supreme Court again confirmed the reserved rights doctrine in Arizona v. California, 373 U.S. 546 (1963). The Court there applied the reserved rights doctrine to five Indian reservations on the lower Colorado River, as well as to other types of federal reservations. Id. at 601.

The Supreme Court in Winters held that the Fort Belknap Reservation was entitled to water even though it meant that settlers, who had acquired their homesteads pursuant to public land laws and

commenced water use after the creation of the reservation but before the Indians began diverting water, had to yield to the Indians' priority. The Court so ruled despite the allegation by the non-Indian water users that the contested waters:

> are indispensable to defendants, are of the value of more than $100,000 to them, and that if they are deprived of the waters their lands will be ruined, it will be necessary to abandon their homes, and they will be greatly and irreparably damaged, the extent and amount of which damage cannot be estimated, but will greatly exceed $100,000 and that they will be wholly without remedy if the claim of the United States and the Indians be sustained. Winters v. United States, supra at 570.

In other words, in determining reserved water rights, if the reservation is senior on a stream, a court cannot consider whether or not there is an economic effect on persons who later settle in the area. The Special Master must follow these cases.

The law as stated in Winters, and more recently in Arizona v. California, supra, must be understood in order to dispel as immaterial any objection by the junior water users that confirmation of the reserved right will be an economic catastrophe. The United

States, however, would like to make clear that the reserved right claims asserted in this case will by no means cause an economic catastrophe. There was no credible evidence presented to the contrary. We intend only to show the strength of the doctrine.

In Arizona v. California, 373 U.S. 546 (1963), Indian claims to water from the Colorado River for reservation lands in Arizona were in issue. Arizona argued that:

> the judicial doctrine of equitable apportionment should be used to divide the water between the Indians and the other people in the State of Arizona.
> The . . . argument is easily answered. The doctrine of equitable apportionment is a method of resolving water disputes between States . . . an Indian Reservation like a State, equitable apportionment would still not control since, under our view, the Indian claims here are governed by the statutes and Executive Orders creating the reservations. (Emphasis added.) Id. 596-97.

In Cappaert v. United States, 426 U.S. 128, 138-139 (1976), the Court again specifically rejected a "balancing of interests" approach:

Nevada argues that the cases establishing the doctrine of federally reserved water rights articulate an equitable doctrine calling for a balancing of competing interests. However, an examination of these cases shows they do not analyze the doctrine in terms of a balancing test. For example, in Winters v. United States, supra, the Court did not mention the use made of the water by the upstream landowners in sustaining an injunction barring their diversion of water. The 'Statement of the Case' in Winters notes that the upstream users were homesteaders who had invested heavily in dams to divert the water to irrigate their land, not an unimportant interest. The Court held that when the Federal Government reserves land, by implication it reserves water rights sufficient to accomplish the purposes of the reservation. 4/

4/ Nevada is asking in effect, that the Court overrule Arizona v. California, 373 U.S. 546 (1963), and United States v. District Court for the County of Eagle, 401 U.S. 520 (1971), to the extent that they hold that the implied reservation doctrine applies to all federal enclaves since in so holding those cases did not balance the 'competing equities.' Brief for Nevada 15. However, since balancing the equities is not the test, those cases need not be disturbed. 426 U.S. at 138-39.

In State of New Mexico v. Aamodt, 537 F.2d 1102 (10th Cir. 1976), the question of impact was also raised:

> The State makes much of the economic effect on the non-Indians who were awarded lands by the 1933 Act if the Pueblos have a right prior to them. In Cappaert, U.S. at ___, 96 S. Ct. at 2070, 44 LW at 4759, the Supreme Court rejected the argument that equity calls 'for a balancing of competing interests.' We reach the same conclusion. 537 F.2d at 1113.

One other recent decision of the Supreme Court has been invoked by the State of Wyoming from time to time in the context of impact. In United States v. New Mexico, 438 U.S. 696 (1978), the Supreme Court considered for the first time whether the reserved rights doctrine extends to water for national forests. 438 U.S. at 705. 1/

> The question posed in this case--what quantity of water, if any, the United

1/ In Arizona v. California, supra, claims to water had been submitted by the United States for national forests in the Colorado River watershed. However, the national forest claims were all on tributaries of the mainstem of the Colorado River. The Special Master chose not to rule on tributary claims. Arizona v. California, Report of the Special Master, December 5, 1960, pp. 291-92. The Supreme Court approved of the Special Master's decision. Arizona v. California, supra at 595.

States reserved out of the Rio Mimbres when it set aside the Gila National Forest in 1899--is a question of implied intent and not power. 438 U.S. at 698.

The Court determined that the national forests were created for two purposes, to "conserve the water flows, and to furnish a continuous supply of timber to the people. 438 U.S. at 707. The legislative history of the national forest organic act revealed that a principal purpose of the national forest system was "as a means of enhancing the quantity of water that would be available to the settlers of the arid west". Id. at at 713. The Court then examined the forests' water requirements and compared them with competing needs for water. The Court found that if there was a reserved water right for the forests it could in that case result in a "gallon-for-gallon reduction in water available for water-needy states and private appropriators".

Given the dual purpose of water for national forests the Court considered the effect on private appropriators in defining the reserved right for the national forests. This was understandable given the dual purpose found by the Court (but see

the dissenting opinion). Just as clearly, the Winters Court, and all courts deciding Indian water rights or other water rights without dual purposes have properly excluded such considerations.

Thus New Mexico is not a departure from other reserved rights cases regarding Indian reservations. Those reservations were established for the exclusive benefit of the Indians and are intended to protect the Indians in their land and water use from encroachment by neighboring non-Indians.

As discussed earlier, the Supreme Court was asked in Winters and other cases to consider the adverse impacts on other water users that a reserved water rights would cause. In the case of Indian reservations and the national monument in Cappaert, the Court found those impacts irrelevant. Nothing in those decisions is inconsistent with New Mexico.

II

RESERVED WATER RIGHTS EXIST IN WYOMING

The State of Wyoming has taken the position that there are no federal reserved water rights in the State. As grounds, therefor, they rely upon the State Constitution, Article VIII. Questions concerning federal reserved rights "including the volume

and scope of particular reserved rights, are federal questions . . .", United States v. District Court in and for the County of Eagle, 401 U.S. 520, 526 (1971). "Federal water rights are not dependent upon state law or state procedures . . .", Cappaert v. United States, supra, citing Colorado River Water Conservation District v. United States, 424 U.S. 800, 807-809 (1976). The reserved water rights of the United States are not affected by Wyoming's admission to the Union, the Wyoming Constitution, the equal footing doctrine, or the doctrine of estoppel.

The admission of Wyoming to the Union of the United States did not affect the power of the United States to reserve water within Wyoming. This issue was expressly resolved by the Supreme Court in Arizona v. California, supra. There "Arizona argue[d] that the United States had no power to make a reservation of navigable waters after Arizona became a State . . ." Id. at 596. The Court responded that Arizona's contentions were unacceptable based upon ". . . the broad powers of the United States to regulate navigable waters under the Commerce Clause and to regulate government lands under Art. IV, §3, of the Constitution. We have no doubt about the power of the United States under these clauses to reserve

water rights for its reservations and its property". Id. at 597-598. See also, Cappaert v. United States, supra, in which the Court found that the United States had reserved water for the Devil's Hole National Monument on January 17, 1952, a date well after the admission of Nevada to statehood in 1864.

Article VIII, §1, of the Wyoming Constitution does not affect the right or power of the United States to create or assert reserved water rights. In Eagle County it was asserted that the provisions of the Colorado Constitution which gave the state ownership of the waters deprived the United States of the right to create reserved water rights. The Court summarily disposed of this argument:

> As we said in Arizona v. California, 373 U.S. 546, the Federal Government had the authority both before and after a State is admitted into the Union 'to reserve waters for the use and benefit of federally reserved lands.' Id. at 597. United States v. District Court for Eagle County, supra at 522-23.

The Supreme Court in Eagle County, supra, merely followed the dictate in Winters, supra, and Arizona v. California, supra, that the very act of establishing a federal reservation impliedly reserves the appurtenant waters necessary for the fulfillment of the purposes of the reservations. Thus, as part of its decree

in Arizona v. California, reported at 376 U.S. 340 (1964), the Court awarded reserved rights to the extent reasonably necessary to fulfill the purposes for which the reservations were created.

Subsequent to the Eagle County decision, the Supreme Court in Colorado River Water Conservation District v. United States, 424 U.S. 800 at 805 (1976), flatly said "[t]he reserved rights of the United States extend to Indian reservations and other federal lands such as national parks and forests". The Supreme Court reiterated this position in Cappaert v. United States, supra, the first reserved water rights case to deal with groundwater:

> In so doing the United States acquires a reserved right in unappropriated water which vests on the date of the reservation and is superior to the rights of future appropriators. Reservation of water rights is empowered by the Commerce Clause, Art. I, §8, which permits federal regulation of federal lands. The doctrine applies to Indian reservations and other federal enclaves, encompassing water rights in navigable and non-navigable streams. Colorado River Water Cons. District v. United States, 424 U.S. 800, 805 (1976);

> United States v. District Court for Eagle County, 401 U.S. 520, 522-523 (1971); Arizona v. California, 373 U.S. 546, 601 (1963); FPC v. Oregon, 349 U.S. 435 (1955); United States v. Powers, 305 U.S. 527 (1939); Winters v. United States, 207 U.S. 564 (1908). 426 U.S. at 138.

This conclusion was again reached in United States v. New Mexico, supra, wherein it was declared:

> The Court has previously concluded that Congress, in giving the President the power to reserve portions of the federal domain for specific federal purposes, impliedly authorized him to reserve 'appurtenant water then unappropriated to the extent needed to accomplish the purpose of the reservation.' 438 U.S. at 699-700. (Emphasis in original.)

Many states have similar provisions in their constitution which have not deterred the courts from recognizing federal reserved rights within those states. The following is a chart of western states indicating provisions in their constitution which are the same or similar to Article VIII, §1 of the Wyoming Constitution and listing representative cases which recognize federal reserved rights within those states.

State Provisions	Cases
Wyoming Const. Art. VIII, §1	United States v. Hampleman, Tribes' WR Ex. 2, (D.Wyo. 1916); Merrill v. Bishop, 69 Wyo. 45, 51, 237 P.2d 186, (1951); Merrill v. Bishop, 74 Wyo. 298, 287 P.2d 620 (1955).
Colorado Const. Art. XVI, §6	United States v. District Court of Eagle Co., supra; Colo. R. Water Conservation District v. United States; United States v. City and County of Denver, infra.
New Mexico Const. Art. XVI, §2 California Const. Art. XIV, §1	United States v. New Mexico, infra. Arizona v. California, supra.
Idaho Const. Art. XV, §1	Avondale Irrigation District v. North Idaho Properties, 96 Ida. 1, 523 P.2d 813 (1974).
Montana Const. Art. III, §1	Winters v. United States, infra; Conrad Investment Co., v. United States, 161 Fed. 829 (9th Cir. 1908).
Washington Const. Art. XXI, §1	Colville Confederated Tribes v. Walton, 647 F.2d 42 (9th Cir. 1981); United States v. Anderson (E.D. Wash. 1979) affirmed 9th Cir. August 22, 1980.
Arizona Res. Stat. §45.101	Arizona v. California, supra.
Oregon Res. Stat. §537.110	United States v. Adair, 478 F. Supp. 336 (D. Ore. 1979).
Nevada (no provision)	Cappaert v. United States, supra.

It should be noted that Michael D. White (Special Assistant Attorney General for Wyoming herein) as Master-Referee in In the Matter of the Application for Water Rights of the United States of America, Water Division 4, 5, and 6 etc., Civil Nos. Div. 4, W425-W438; Div. 5, W467, W469; Div. 6, W85, W86; Summit Co., 2371; Eagle Co., 1529, 1548; Grand Co., 1768. Decided Aug. 6, 1976, appeal pending, sub nom. United States v. City and County of Denver, Civil Nos. 79-SA-99, 79-SA-100, found that reserved water rights existed and were created in Colorado before and after statehood notwithstanding the Colorado constitutional provision and prior rulings of the Colorado Supreme Court. See, "Partial Master-Referee Report Covering All of the Claims of the United States of America," Findings of Fact and Conclusions of Law, pages 428-429.

The equal footing doctrine does not affect the existence or non-existence of reserved water rights within Wyoming. The equal footing doctrine was raised in connection with reserved water rights the first time that issue was presented to the Supreme Court. In Winters v. United States, supra, the Court said:

> [a]nother contention of appellants is that if it be conceded that there was a reservation of the waters of the Milk River by the agreement of 1888, yet the reservation was repealed by the admission of Montana into the Union, February 22, 1889, c. 180 25 Stat. 676, upon equal footing with the original states.

To this the Court responded "[t]he power of the Government to reserve the waters and exempt them from appropriation under the state laws is not denied, and could not be. The United States v. The Rio Grande Ditch & Irrigation Co., 174 U.S. 690, 702; United States v. Winans, 198 U.S. 371." Id. at 577. This view was reiterated by the Supreme Court many times most recently in United States v. New Mexico, supra, the most recent of the cases dealing with reserved water rights. The Court in United States v. New Mexico, Id. at 698, clearly restated the proposition:

> [t]he Court has previously concluded that whatever powers the States acquired over their waters as a result of congressional Acts and admission into the Union, however, Congress did not intend thereby to relinquish its authority to reserve unappropriated water in the future for use on appurtenant lands withdrawn from the public domain for

> specific federal purposes. Winters v. United States, 207 U.S. 564, 577 (1908); Arizona v. California, 373 U.S. 546, 597-598 (1963); Cappaert v. United States, 426 U.S. 128, 143-146 (1976).

See also, United States v. District Court of Eagle County, supra, at 522-23. If the equal footing doctrine did not deprive the United States of reserved water rights in Montana, Colorado, Arizona, California, Nevada, New Mexico, Idaho, Washington and Oregon, it appears clear that it would not have that effect in Wyoming, thereby making Wyoming "more equal" than her sister states.

Finally, both federal and state courts in Wyoming and Wyoming law itself, recognize that the United States retains reserved water rights for the benefit of the Wind River Indian Reservation. The territory of Wyoming was created by the Act of July 25, 1868, 15 Stat. 178. That statute provided that ". . . nothing in this act shall be construed to impair the rights of persons or property now pertaining to the Indians in said territory, so long as such

rights shall remain unextinguished by treaty between the United States and such Indians". As noted by the Wyoming Supreme Court in Moore v. Board of County Commissioners, 2 Wyo. 8 (1877), the territory was created subsequent to the July 3, 1868, treaty that created the reservation and thus the territorial act was ". . . subject to the treaty, because the treaties of the United States control its statutes". Id. at 19.

Prior to Wyoming's admission into the Union as a state, the United States still retained primary sovereignty over the waters within the territory. Willey v. Decker, 11 Wyo. 496, 535 (1903). Rights to use water acquired by Indians pursuant to federal law or treaties prior to Wyoming statehood were not subject to divestment by the territorial government, Willey v. Decker, supra, particularly in view of the explicit limitation on the territory's legislative power restraining it from interfering with Indian property rights.

Pursuant to the Act of July 10, 1890, 26 Stat. 222, the State of Wyoming was admitted into the union and its constitution

was ratified and confirmed. That constitution explictly provides that ". . . all obligations against the territory of Wyoming, of whatever nature, and the rights of individuals, and of bodies, shall continue as if no change had taken place in this government . . ." (Wyo. Const., Act II, Sec. 3). The Wyoming Constitution also states that "private property shall not be taken for private use unless by consent of the owner, except for private ways of necessity, and for reservoirs, drains, flumes or ditches across the lands of others for agricultural, mining, milling, domestic or sanitary purposes, nor in any case without due compensation. Wyo. Const., Art. I, Sec. 3. Finally, the people of Wyoming, by their constitution, agreed and declared that they forever disclaimed all right and title to all lands lying within the limits of the State owned or held by any Indian and Indian tribe and that, until such time as the Indians' title shall be extinguished by the United States, the Indian property would remain under the absolute jurisdiction and control of the United States. Thus, it was held in United States v. Parkins, 18 F.2d 642 (D. Wyo., 1926), that:

> It is not apparent that the waters in the streams within the Indians reservation were ever specifically granted by the United States to the State of Wyoming, although it apparently is the fact that the Indian service, in promulgating its irrigation project and the officials of the State of Wyoming, for the purpose of protecting all landowners who may acquire water rights, have co-operated along the line of taking out water for irrigation purposes with the consent of the State. It must be assumed, however, in the absense of any specific grant, that the government has reserved whatever rights may be necessary for the beneficial use of the government in carrying out its previous rights; those rights having become fixed and established before the act of admission which made Wyoming a sovereign state. The treaty in this case, like all other treaties with the Indians creating reservations, contemplates the use and benefit of the lands within the reservation to its wards, the Indians, which likewise includes the irrigation of those lands. Winters v. United States, 207 U.S. 564, 28 S.Ct. 207, 52 L.Ed. 340. So far as the issues here are concerned, it would appear that the government, in the establishment of the irrigation project, had a right to the use of the present waters of Mill Creek for the Indians. Id. at 643.

The Supreme Court of Wyoming itself has recognized that "By the establishment of the Wind River Indian Reservation on July 3, 1868, the United States became the trustee of the Shoshone Tribe of Indians holding legal title to all of the lands and waters of the Wind River Indian Reservation. . . ." Merrill v. Bishop, 69 Wyo. 45, 53 (1951).

III

RESERVED WATER RIGHTS INCLUDE GROUNDWATER

Reserved water rights can exist in either surface or groundwater. Cappaert v. United States, supra at 143. In Cappaert the Court faced the question of whether a reserved water right to maintain a species of fish extended to the maintenance of groundwater. The Court found that it did, stating:

> Since the implied reservation-of-water doctrine is based on the necessity of water for the purpose of the federal reservation, we hold that the United States can protect its water from subsequent diversion, whether the diversion is of surface or groundwater. Id. at 143.

The Ninth Circuit in Colville Confederated Tribes v. Walton, 647 F.2d 42, 46 (9th Cir. 1981), confirmed the view that there exist reserved water rights in groundwater. See also, United States v. Adair, 478 F.Supp. 336 at 345 (D. Ore. 1979); Tweedy v. Texas, 286 F.Supp. 383 at 385 (C.D. Mt. 1968). Michael D. White, as Master-Referee in Colorado, also found that the United States' reserved water rights include groundwater. See, "Partial Master-Referee Report Covering All of the Claims of the United States of America", supra, "Findings of Fact and Conclusions of Law", page 429.

IV

RESERVED WATER RIGHTS FOR THE WIND RIVER INDIAN RESERVATION

In this aspect of the case the United States is claiming reserved water rights for the Wind River Indian Reservation. The reserved water rights doctrine as set out in the preceeding sections is the basis for the United States' claim for reserved water rights on behalf of the Shoshone and Arapahoe Tribes of the Wind River

Indian Reservation. The United States in establishing the Wind River Indian Reservation as a "permanent home" for the Indians thereby reserved sufficient water for the present and future needs of that reservation. Treaty with Shoshone and Bannacks, (second treaty of Fort Bridger), July 3, 1868, 15 Stat. 673, Art. 4. This purpose is much broader when compared to those of the other federal reservations claimed in this case. See, United States' Legal Parameters in support of the United States' Statement of Claims, filed March 6, 1979. Included under this purpose of establishing a "permanent home" are uses for agriculture, livestock, fisheries and wildlife, mineral development, municipal and industrial uses, and aesthetics.

At the date of the creation of the Wind River Indian Reservation, July 3, 1868, sufficient water was impliedly reserved from appurtenant surface and underground sources to fulfill the purposes of the reservation. See, Cappaert v. United

States, supra; Arizona v. California, supra; Winters v. United States, supra. As set forth in the Treaty with the Shoshone and Bannacks, the purpose of the Wind River Indian Reservation was (and is) to provide a "permanent home" for and insure the civilization of the Indian tribes settled thereon. Treaty with the Shoshone and Bannacks, July 3, 1868, 15 Stat. 673 Art. 4. Thus, the reserved water right of this Indian reservation is measured by the water required for the present and future needs of the reservation in creating an economically self-sufficient homeland. See, United States v. Shoshone Tribe, 304 U.S. 111 (1938). As stated above, these needs include water for agriculture, livestock, fisheries and wildlife, mineral development, municipal and industrial uses, and aesthetics. See, Arizona v. California, supra; Winters v. United States, supra; United States v. Anderson, No. 3643 (E.D. Wash. July 23, 1979); United States v. Adair, 478 F.Supp. 336 (D. Ore. 1979).

The reserved water right of the Tribes, even if unquantified, is a vested property interest. See, Arizona v. California, supra at 600. Reserved water rights do not depend on state law

or procedure for their existence. They come into existence by virtue of the same act by which the reservation was created--a federal action, not a state action. Their existence is determined by the purposes for which the reservation was created--a federal action, not a state action. Their existence is determined by the purposes for which the reservation was established. See, Cappaert v. United States, supra, at 145; United States v. Anderson, supra; United States v. Adair, supra. Thus, unlike appropriative rights, reserved rights cannot be lost by non-use. See, Arizona v. California, supra; Winters v. United States, supra.

The landmark decision in Winters v. United States, supra, dealt with the Fort Belknap Reservation. The background of the Wind River Indian Reservation is, in significant aspects, virtually identical to that of the Fort Belknap Reservation. When one understands for the factual context in which Winters was decided, it becomes clear that the doctrine applies in this case. Like the Fort Bleknap situation, the Shoshone Tribe exchanged land for the Wind River Indian Reservation. Identical language to that used in Winters could be used to describe what was given up by the Shoshones.

> . . . a very much larger trace which the Indians had the right to occupy and use. . . . The lands were arid and, without irrigation, were practically valueless. . . . The Indians had command of . . . all their beneficial use, whether kept for hunting 'and grazing roving herds of stock,' or turned to agriculture and the arts of civilization. Did they give up all this? Did they reduce the area of their occupation and give up the waters which made it valuable or adequate? . . . If it were possible to believe affirmative answers, we might also believe that the Indians were awed by the power of the Government or deceived by its negotiators. Neither view is possible. United States v. Winters, supra at 576.

As stated earlier, Winters also disposes of the argument that, even if water were impliedly reserved for the Indians, the admission of Wyoming to statehood upon an equal footing with the other states repealed the reservation. In rejecting the equal footing argument, the Court emphasized its decision that the reserved right was "for a use which would be necessarily continued through years. It would be extreme to believe that [with statehood] Congress destroyed the reservation and . . . took from [the Indians] the means of continuing their old habits, yet did not leave them the power to change to new ones." Winters v. United States, supra at 577.

The Supreme Court first confronted the issue of how to quantify reserved rights in Arizona v. California, supra at 577. More than fifty years had passed since Winters by the time Arizona v. California reached the Court. The population and economy of the arid west had grown tremendously with the encouragement of the federal government. Much greater competition existed for scarce water resources, and the reserved rights of the Indian reservations along the Colorado River had gone undeveloped while southern California's increasing use of water gave no sign of abating. In spite of this fact, the Court reiterated the premise of Winters, that when an Indian reservation is established, the government intends to "deal fairly with the Indians by reserving for them the waters without which their lands would have been useless." Arizona v. California, supra at 600. The Court adhered to Winters, holding that the reserved right vested at the time the reservations were established, reasoning that it was "impossible to believe that when Congress . . . and . . . the Executive . . . created . . . reservations they were unaware that most of the lands were of the desert kind--hot, scorching

sands--and that water from the river would be essential to the life of the Indian people and to the animals they hunted and the crops they raised". Id. at 599.

The Court, following the holding in Winters that the use of the reserved water was intended to continue in future years, and recognizing that contemporary reservation development was not a reliable indicator of the quantity of water reserved, decided that the right should be quantified in terms of both present and future needs.[2/] The Court further concluded that for the Indian reservations involved which were all totally agricultural reservations, irrigable acreage was a reasonable and fair way to measure the right. The Court adopted the Special Master's finding that "enough water was reserved to irrigate the practicably irrigable acreage on the reservation." Id. at 600.[3/]

2/ This idea of fulfilling present and future neds was followed and discussed by Special Master Tuttle in his recent report to the United States Supreme Court, Arizona v. California, No. 8 Original, pp. 90, 91, n. 5; p. 98, n. 23 and 24. See also, United States v. Anderson, supra.

3/ The Supreme Court recently recognized this standard in its 1979 Spplemental Decree in Arizona v. California, 439 U.S. 419 at 421. See also, Special Master Tuttle's report, p. 91.

The Supreme Court in Arizona v. California clearly recognized that agriculture was the most productive use of the reservation lands in that case and thus quantified the water rights in terms of irrigation requirements.[4/] The Wind River Indian Reservation, however, is far more abundant in resources than the "hot, scorching sands" of the Colorado River Reservations. In sharp contrast to the land along the lower Colorado, the valley of the Wind River Mountains in the mid-19th century evoked the following description:

> The valley . . . is the territory which the tribe have selected for their home . . . The country abounds in game, has a very mild climate, and possesses agricultural advantages which makes it a great desideratum to the white man. Numerous oil springs have been discovered and located in the valley of the Pawpawgee, but this tribe are strongly opposed to any invasion of their territory by the whites. Letter from Luther Mann, Jr., Indian agent, to F.H. Head, Superintendent of Indian Affairs, Fort Bridger Agency, September 15, 1866.

4/ Special Master Rifkind also allowed water for stock watering and domestic purposes. See, Special Master's Report to Supreme Court in Arizona v. California at 262.

The Shoshone selected the lands for the Wind River Indian Reservation because they were of the best quality and suited to a wide variety of uses. Negotiation of the second Treaty of Fort Bidger concluded as the Shoshone Chief Washakie expressed his enthusiastic approval:

> Washakie chief of the Shoshones was apparently greatly pleased and spoke in effect as follows: I am laughing because I am happy. Because my heart is good. As I said two days ago, I like the country you mentioned then, for us, the Wind River Valley . . . The Wind River . . . I want for my home the valley of Wind River and the lands on its tributaries as far east as the Popo-agie, and want the privilege of going over the mountains to hunt where I please. Letter from General C. C. Augur to the President of the Indian Peace Commission, October 11, The Wind River . . . I want for my 1868. National Archives Record Group 75, Office of Indian Affairs, Washington, D.C. Indian Office Records.

As has been noted, in addition to the agricultural potential, the mineral and fish and game resources made the selection of the reservation highly desirable. Their development and conservation are integral to the economy and quality of

reservation life that were intended in setting aside the Wind River Indian Reservation for the "absolute and undisturbed use and occupation" of the Indians. Article 2, Treaty with the Shoshone and Bannacks, supra. For the Tribes to remain politically and culturally intact as Congress has directed, they must maintain a reservation life and economy. Development of the manifold resources of the reservation, therefore, is both a right and a necessity. The Indians surrendered their much larger domain in exchange for the Wind River Indian Reservation, a contract which Congress has shown no intention of abrogating, and water is the essential element for reservation existence. Without a reservation of water for all of these needs, the Tribes cannot develop and maintain the viable, economically self-sustaining homeland that was contemplated in the second treaty of Fort Bridger.

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The existence of reserved water rights for uses of water other than for irrigation has been recognized in recent decisions. The United States' and the Tribes' positions are

strongly supported by Colville Confedrated Tribes v. Walton, supra. This important new decision proclaims clearly that an Indian tribe has reserved water rights to maintain even a replacement fishery made necessary by the destruction of a tribe's historic fishing grounds by the construction of dams, supra at 48.

United States v. Anderson, No. 3643 (E.D. Wash., decided July 23, 1979), also holds that in addition to agriculture, a purpose of the Spokane Indian Reservaton was to maintain the fisheries of the Chamokane Creek. Slip Op. at 9-11. As such, the Court awarded "sufficient water to preserve fishing in Chamokane Creek", Id., as well as "sufficient water to irrigate all of the practicably irrigable acres", Id. at 5.

In United States v. Adair, supra, the Court found that the United States Treaty of 1864 with the Klamath and Modoc Tribes reserved to them the exclusive right of taking fish in the streams and lakes of the Klamath Reservatin. Termination of the reservation, including the extinguishment of Indian land title in 1954, did not abrogate the Indians' reserved water rights to "as much water on the Reservation lands as they need[ed] to protect their hunting and fishing rights". Id. at 345.

The Treaty of July 3, 1868, 15 Stat. 673, creating the Wind River Indian Reservation, does establish the hunting and fishing rights of the Shoshone, and now the Arapahoe, Tribe. It, therefore, follows from the uncontradicted precedent of the foregoing cases that a purpose of the Wind River Indian Reservation was to maintain fisheries for the use and enjoyment of the Tribes.

The State of Wyoming has suggested during trial that the presence of non-Indian-owned fee land adjacent to streams of the Wind River Indian Reservation has somehow abrogated this tribal reserved water right to maintain fisheries. None of the cases dealing with the question suggest any such things. In fact, Walton and Anderson each deal with Indian reservations on which fee-owned land exists, some undoubtedly along streams and rivers. Adair involves fishing rights for a terminated reservation. Proof of ownership of the riparian lands or of streambeds is not a prerequisite or element of proof to the making out of a claim for a reserved water right for maintenance of fisheries.

Nothing in Montana v. United States, 450 U.S. 544 (1981), deals in any way with reserved water rights for maintenance of

fisheries. Neither it nor any other case suggests that loss of Indian land title adjacent to reservation streams defeats a tribal claim for sufficient instream flows for fish.

It is, therefore, indisputable that the Shoshone and Arapahoe Tribes may claim a reserved water right to maintain fisheries on the Wind River Indian Reservation in addition to those needs for water related to agriculture and other beneficial uses.

V

RESERVED WATER RIGHT FOR MINERAL DEVELOPMENT

The Wind River Indian Reservation's history is replete with references to the mineral resources whose commercial value was recognized early by both Congress and the Executive. To the extent that water is required for development of the reservation's mineral resources, it was impliedly reserved by the 1868 Treaty. The United States was aware of the reservation's mineral resources in 1868. See, Letter dated September 15, 1886 from Mann to Head quoted above. The Supreme Court held that it was known that the Wind River Indian Reservation contained timber and valuable mineral deposits, and that the right to those resources was given

to the Shoshones under the second treaty of Fort Bridger. United States v. Shoshone Tribe, supra.

The Shoshone case involved a claim by the Tribe for the value of an undivided half of the Wind River Indian Reservation lost by the Shoshones when the Arapahoes were placed on the reservation in 1878. In describing the reservation the Court said:

> It was known [in 1868] to contain valuable mineral deposits--gold, oil, coal and gypsum. It included more than 400,000 acres of timber, extensive well-grassed bench lands and fertile river valleys conveniently irrigable. Id. at 114. 5/

and again:

> The Treaty, though made with the knowledge that there were mineral deposits and standing timber in the reservation, contains nothing to suggest that the United States intended to retain for itself any beneficial interest in them. Id. at 117 (emphasis added).

5/ This is not a complete inventory of the valuable resources on the Wind River Indian Reservation.

The Special Master can do nothing other than recognize the established fact that by the second treaty of Fort Bridger it was intended that the Indians have the full benefit of all minerals and timber resources on the reservation. If water is necessary to develop any of these resources, under the principles cited above the right to use that amount of water necessary to develop the resource was reserved for the benefit of the Indians on July 3, 1868.

Albeit true that the claims for the Indians' purposes are broader than the other federal reservations claimed in this action, the Indians are entitled to greater quantities of water than the other federal land areas. The essential purpose of Indian reservations is to make the land and resources productive for people, while most other federal reservations are dedicated to the protection of their natural resources. Compare, Arizona v. California, supra at 600-601, with United States v. New Mexico, supra and Cappaert v. United States, supra.

Congress is presumed to have "dealt fairly" with Indian tribes and the documents establishing the reservations "are not to be interpreted narrowly ". Santa Clara Pueblo v.

Martinez, 436 U.S. 49, at 70 n. 30 (1978); Morton v. Ruiz, 415 U.S. 199, at 236 (1974); United States v. Shoshone Tribe, supra at 166. Ambiguities are to be resolved in the favor of the Indians. United States v. Winters, supra. Simply stated, broader rules of construction apply in determining the Indian reserved rights than when dealing with other federal reservations.

VI

PRIORITY DATES

In this case a separate trial was conducted on reservation dates and boundaries. The United States hereby incorporates by reference its brief on reservation dates except as set forth below. Due to recent developments in the case law, the United States must revise that portion of its earlier brief regarding boundaries and priority dates filed August 29, 1980, that deals with reacquired lands.

On June 1, 1981, the Ninth Circuit Court of Appeals issued its decision in Colville Confederated Tribes v. Walton, supra. That decision held that when a non-Indian purchases allotted land from an Indian that has put to use all or a portion of his pro-rata share of the reservation reserved water right, that the non-Indian purchaser acquires that share of the reserved water right in use at the time of acquisition or which he appropriates with reasonable diligence. thereafter. The non-Indian also acquires the priority date of the reservation. Id. at 51. The United States believes that when the Ninth Circuit's reasoning is, with one exception, followed through to its logical conclusion regarding the Wind River Indian Reservation, that the result is that all reservation land that had gone out of trust status and has since been reacquired in trust retains the priority date as of the creation of the original reservation.

Several cases have dealt with Indian water rights and what becomes of them when the land is allotted and subsequently sold to a non-Indian. U.S. v. Powers, 305 U.S. 527 (1939); Colville Confederated Tribes v. Walton, supra; U.S. v. Anderson, supra; U.S. v. Adair, supra; U.S. v. Ahtanum Irrigation District, 236 F.2d 321 (9th Cir. 1956); U.S. v. Hibner, 27 F.2d 909 (D. Idaho 1928). We are aware of no cases extending the Indian reserved water rights to lands acquired by non-Indians pursuant to acts such as the Act of March 3, 1905. 33 Stat. 1016.

We believe that the Ninth Circuit's finding in Colville Confederated Tribes v. Walton, supra, should generally be followed in this case.[6/] It of course then follows that when the former allotment is reacquired in trust for the Indians, the original priority date of July 3, 1868, is applicable to the water rights appurtenant to that land. The quantity of that water will be discussed below.

The one exception to the Colville reasoning mentioned earlier deals with reacquired land that was not formerly allotted to an individual Indian. These would be lands homesteaded under the 1905 Act. We firmly believe, and the language of that Act supports, the position that when the land was purchased under the 1905 Act, the non-Indian purchaser received no share of the Indian water right or the associated priority date of July 3, 1868. Article X of the 1905 Act expressly provides that nothing in it:

> shall be constructed to deprive the . . . Indians . . . of any benefits to which they are entitled under existing treaties or agreements, not inconsistent with the provisions of this agreement.

The law is well-settled that the issuance of a federal patent to non-Indians does not carry with it any federal water right. California Oregon Power Co. v. Beaver Portland Cement Co., 295 U.S. 142, 160-63 (1935). As the United States has previously

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6/ The United States reserves the right to contest any non-Indian successor's claim to any unused portion of the reserved right.

stated, nothing in the 1905 act abrogated the reserved water rights for the Wind River Indian Reservation. See, "Brief of the United States Concerning the Boundaries of the Wind River Indian Reservation and the Priority of Water Rights for Lands Within the Reservation", pp. 6-15.

The question is then raised, if the homesteaded land is subsequently reacquired in trust for the Indians, how are they then entitled to an 1868 priority? The answer follows from the underlying reasoning in Colville Confederated Tribes v. Walton, supra. There the Ninth Circuit, in deciding that an Indian allottee could convey his currently used reserved water right to a non-Indian purchaser, stated:

> The general rule is that termination or diminution of Indian rights requires express legislation or a clear inference of Congressional intent gleaned from the surrounding circumstances and legislative history. See, Bryan v. Itasca County, 426 U.S. 373, 392-93, 96 S.Ct. 2102, 2112-13, 48 L.Ed. 710 (1975); Mattz v. Arnett, 412 U.S. 481, 504-05, 93 S.Ct. 2245, 2257-58, 37 L.Ed.2d 92 (1972).

The court in Colville was careful to limit the quantity of water that the non-Indian purchaser acquired to that amount that was currently in use or was put to use thereafter with reasonable

diligence. This was to effectuate the allotment policy and insure that the Indian seller's right and therefore his land's value was not diminished. Id. at 50. The Indian allottee had to be allowed to compete on an equal basis and offer his land with the same benefits as a non-Indian irrigator.

The court did not allow the unused reserved right to be conveyed to the non-Indian except as could be diligently developed after purchase and clearly did not allow the non-Indian to enjoy the protection of non-use, reasoning that he was "under no competitive disability vis-a-vis other water users". Id. at 51. The Winters doctrine is intended for the benefit of Indians, to protect them from the harshness of the prior appropriation system, so that water will be reserved and available for Indian use when they are ready to use it. It is like a tax exemption or a restraint on alienation, protecting the Indians from the more competitive and technologically advanced Anglo culture. The non-Indian successor in interest does not need the protection of the Winters doctrine and no federal purpose is promoted by transferring any more water than is necessary.

The court, however, clearly did not rule that the remaining, unused water right was forever lost. Ibid. The allowance of the non-Indian to develop unused water for a reasonable period afterward is a clear indication that the reserved right did not vanish. What then became of the unused and undeveloped water right? We firmly believe that the most correct, consistent and equitable position is that the unused water right remains with the Tribes.

Prior to the allotment process or sale under the 1905 Act, the Tribes owned their reserved water in two senses--as proprietors and as sovereigns. The rights of the Tribes were changed or diminished only to the extent necessary to fulfill the purpose of the allotment program, no more. The Indian water that was "reserved . . . and exempt . . . from appropriation under State laws", Winters v. United States, supra at 577, is and must be measured by all lands within a reservation at the time of its creation and does not fluctuate depending upon the status or ownership of land within the reservation at any particular time. When the Wind River Reservation was established there was reserved and exempted from appropriation a block of water that is necessary

to fulfill the reservation's purposes. Winters v. United States, supra. The Tribes, as the beneficial owners of the lands encompassed within the reservation boundaries, have the right to use that block of water on their lands which vested no later than the date of reservation. Arizona v. California, supra at 600-601. In addition, the Tribes, as the governing authority over the reservation, have the right to control the use of that block of water. Montana v. United States, supra at 566; Colville Confederated Tribes v. Walton, supra at 52. Thus, the Supreme Court in Montana v. United States stated:

> To be sure, Indian tribes retain inherent sovereign power to exercise some forms of civil jurisdiction over non-Indians on their reservations, even on non-Indian fee lands. A tribe may regulate, through taxation, licensing, or other means, the activities of non-members who enter consensual relationships with the tribe or its members, through commercial dealing, contracts, leases, or other commercial arrangements. Williams v. Lee, 358 U.S. 217, 223; Morris v. Hitchcock, 194 U.S. 384; Buster v. Wright, 135 F.2d 947, 950 (CA 8); see Washington v. Confederated Tribes of the Colville Indian Reservation, ____ U.S. ____. A tribe may also retain inherent power to exercise civil authority over the conduct of non-Indians on fee lands within its reservation when the conduct threatens or has some direct effect on the political integrity, the economic security, or the health

or welfare of the tribe. See Fisher v. District Court, 424 U.S. 382, 386; Williams v. Lee, 358 U.S. 217, 220; Montana Catholic Missions v. Missoula County, 200 U.S. 118, 128-129; Thomas v. Gay, 169 U.S. 264, 273 15/

15/ As a corollary, this Court has held that the Indian tribes retain rights to river waters necessary to make their reservations livable. Arizona v. California, 373 U.S. 545, 599.

See also, Merrion v. Jicarilla Apache Tribe, ___ U.S. ___, 71 L.Ed. 2d 21 at 32-34 (1982); Washington v. Confederated Tribes of the Colville Indian Reservation, 447 U.S. 134, 152-154 (1980); United States v. Wheeler, 435 U.S. 303, 322-323 (1978); United States v. Mazurie, 419 U.S. 544, 556-558 (1975); Cardin v. DeLa Cruz, No. 80-3244 (9th Circuit) decided March 15, 1982; Knight v. Shoshone and Arapahoe Tribes, 670 F.2d 900 (10th Cir. 1982); Confederated Salish and Kootenai Tribes v. Namen, 665 F.2d 951 (9th Cir. 1982); Confederated Colville Tribes v. Walton, supra at 52. In arid central Wyoming nothing could affect the "political integrity, the economic security, or the health or welfare of the tribe[s]" more than the water in the Big Horn River system.

The right of the tribe to control the reservation's Winters doctrine rights derives from its inherent sovereign powers; it does not depend on its ownership of the land itself. The sovereign right of a tribe is similar to the right of a state to control the water resources within its jurisdiction unless that aspect of tribal sovereignty has been withdrawn by treaty or statute.[7/] Merrion v. Jicarilla Apache Tribes, supra at 32-34; United States v. Montana, supra at 565; United States v. Wheeler, supra at 322-323.

The quantity of water that is reserved and subject to tribal jurisdiction and control is not reduced when lands that were once tribal are allotted, sold or homesteaded. While the tribe's rights as a proprietor are necessarily diminished when land passes out of tribal ownership, the total amount of water reserved to fulfill the purposes of the reservation and exempt from appropriation under state law remains constant.

7/ The sovereign powers of a state over its water resources are discussed in California v. United States, 438 U.S. 645 (1978). See also 1 Hutchings, Water Rights Laws in the Nineteen Western States 3-8 (1971). The Tribes' control in this instance that portion of the reserved right which has not been affected by the pro-rata reduction by an allottee or his successor. When the land and water is reacquired it is added back to the "surplus" or overall quantity of the reserved right.

When lands that have passed out of tribal onwership are reacquired by the tribes, the tribes' sovereign and proprietary water rights are reunited. As sovereign, the tribes have the right to authorize the use of the reserved water rights on the reacquired parcel, and as owner of that parcel the tribes have the right to put the water to beneficial use. This allows the original intention of reserving a specified quantity of water at the creation of the reservation for the Indians' use when needed, to be effectuated as intended by Congress. This is consistent with the fact that the lands in question never lost their Indian interest and have always remained inside the exterior boundaries of the Wind River Indian Reservation. The result is the same whether the land is formerly allotted or homesteaded.

To hold otherwise would result in the Tribes having numerous priority dates, most of them, in some aspect, junior to to other non-Indian water users. This was clearly not the intent of Congress when it created the Wind River Indian Reservation in 1868.

The United States has not asserted a reserved right claim for the land that was once part of the reservation which was allotted or homesteaded and which has not yet and may never be reacquired in trust for the Tribes. To do so, we believe would have been an unduly burdensome and costly endeavor. As the famous saying goes in this case "we shall cross that bridge when we come to it". The United States proposes that a provision be inserted in the Decree in this case which allows for modifications to the Tribes' reserved right for that land which is subsequently reacquired in trust, that land of course being subject to the same method of quantification as applied to other lands in this case. A provision such as this allows for an orderly handling of this situation and provides for the future needs of the Tribes as the situation arises, if ever.

For the claimed lands which are north of the stipulated boundaries of the Wind River Indian Reservation and which are currently held in trust by the United States for the Tribes, we claim as the applicable priority date, the date of purchase and where applicable, the priority date associated with the state adjudicated water right.

EVIDENCE PRESENTED REGARDING THE QUANTITY OF WATER RESERVED FOR THE WIND RIVER INDIAN RESERVATION

We shall now examine the evidence presented by the parties. This analysis of the evidence will show that the United States, through its experts, presented technically sound and reasonable evidence in quantifying the water claimed for the reservation. We will first address the agricultural water claims and the associated evidence, followed by the non-agricultural water claims.

VII

STATE ADJUDICATED ACREAGE AS PRIMA FACIE PROOF OF IRRIGABILITY

One method used by the United States in determining the practicably irrigable acreage on the Wind River Indian Reservation is the assertion of the State of Wyoming's finding and certification that certain trust acres on the reservation have been irrigated. This finding and certification are found within the official records of the State of Wyoming's State Engineer, which consist of permits, certificates, maps, proofs and orders of the Wyoming State Board of Control.

This information, insofar as it contains official statements and determinations by agencies and employees of the State of Wyoming, is an admission by a party and as such is admissible in evidence against such party, McCormick on Evidence, 2d Ed. 1972, Chap. 26; Weinstein's Evidence, V. 4, §801 (d)(2) [01],

1979. These records contain certification by officials of the State of Wyoming that water was delivered to the lands described and that such systems were placed therein so as to warrant adjudication by the State Board of Control. These statements are admissions by the State of Wyoming that the lands described therein are irrigable. The United States so asserted in its Amended Motion to Take Judicial Notice filed on May 11, 1981. The Special Master addressed himself to this matter and stated:

> THE SPECIAL MASTER: The fact that the --that the water rights were issued in 1905 creates a prima facie situation that these are irrigable lands. That is not to say that the State can't refute that, but the burden, in my opinion, is not upon the United States to prove their irrigability or arability. Now, we're having briefs on this because I may be in error. Tr. p. 5190.

The Special Master called for briefs on the issue and they were filed by the United States and the State of Wyoming. At a later time the Master again addressed himself to the matter when the United States introduced exhibits that identified the claimed adjudicated acreage.

THE SPECIAL MASTER: Mr. Echohawk, let me say that that ruling that it establishes a prima facie case I use with exactly the same legal significance as I do a prima facia recognition of a water right that we used in the stipulation at Worland regarding State water rights. This is not to say that this is not irrefutable. I don't intend to impose the five-year no use abandonment concept on Indian idle lands, but if you have adjudicated lands that have not been irrigated for a long number of years, you may have a prima facie case that a permit existed on it at one given time, but this is not to say I must accept that as lands on which a claim for water will be granted or that the State does not have a right to refute the prima facie materials on record. Tr. 7204-05.

* * *

MR. ECHOHAWK: We are back to the same point of uncertainty that we had last time this point was raised, and you did ask for briefs on that. The question is the way the United States is asserting the State water rights are that it establishes -- it is one way of showing that land is, in fact, irrigable, the same way we have shown that other areas are irrigable. Say, for instance, the North Crowheart, we have put on the soils and engineering and the economics and we are putting on water supply, that sort of thing. We have chosen that method to prove irrigability for that land. What we are doing in this instance is asserting the State water rights as proof of irrigability, the same way that we think it establishes irrigability. My understanding was, Your Honor, you had ruled in our favor it does establish a prima facie case for irrigability.

THE SPECIAL MASTER: I have ruled it establishes a prima facie case for irrigability. Tr. 7205-7206.

* * *

THE SPECIAL MASTER: I would rather think that the fairest way to handle this question would be to put the burden of proof upon the State to show that if certain parcels on some of these areas are not yielding crops, have had a drainage problem, don't deserve water, so to speak, that that I would consider to reduce the number of acres entitled to water on that type of evidence.

Generally speaking, I'm going along with the presumption that if it had a water right issue to it, it's irrigable land. Whether it's entitled to a water claim for reserved water for it, and I don't think -- we are not talking about too many acres in the first place, are we?

MR. ECHOHAWK: We are talking about approximately 17,000 acres, and that's our point exactly.

The State of Wyoming has the same opportunity with regard to the adjudicated lands as they do with regard to the North Crowheart area.

If they want to come in and put on evidence to show that that land isn't irrigable, is not irrigable by whatever method they choose to show, that's one thing.

THE SPECIAL MASTER: Whether it was irrigated and was not yielding productively and went into idle status for ten or fifteen years, because it was not productive land, I think that's acceptable evidence.

MR. ECHOHAWK: But because the land is currently idle, that in and of itself should not bump that land out. They should have to show something else, the same as North Crowheart is.

THE SPECIAL MASTER: No problem. Tr. 7208-7209.

The United States has shown that there are 17,411 acres of trust acreage for which there are State adjudicated water rights. United States Exhibits WRIR C-303 ADJ, WRIR C-304 ADJ; Master's Exhibit 1. In light of the Special Master's rulings that those State rights are prima facia proof of irrigability, the burden shifted to the State of Wyoming to show that they were not irrigable. The State of Wyoming failed to make any such credible showing.

The State of Wyoming conducted no independent soils, engineering or economic studies to show that such land was incapable of sustaining irrigation. The State did review the claimed adjudicated acreage in two separate instances.

The first review was conducted by Mr. Sommers and was apparently an attempt at determining the arability of the adjudicated lands. As we previously pointed out in detail in the "Land Classification" section of this brief, infra, Mr. Sommers did not conduct any independent field review to determine the arability of these lands. Instead, as best we can determine from the sketchy details in the record, Mr. Sommers reviewed materials prepared by the United States' experts and made a judgment based solely upon that data. Wyoming Exhibits WRIR SS-2, WRIR SS-1002.

The problem with Mr. Sommers' analysis, his testmony and his exhibits is that one cannot decipher how he reached his broad brush conclusion that "approximately 50 percent of those lands were non-arable." TR. 1107. The only hard data presented by Mr. Sommers in Wyoming Exhibits WRIR SS-2 and WRIR SS-1002, which show land types IX or "out" lands (845.9 acres) and class 6 lands (2971.7 acres/SS-2 and 360.5 acres/SS-1002) does not begin to reach the 50 percent total. One can only determine that his overall conclusions are unsupported by the record.

Even Mr. Sommers' documented totals are not enough to exclude the lands from consideration in this case. As is discussed in more detail in the following section regarding the unadjudicated acreage in current use claims of the United States, there are many thousands of acres in the Big Horn Basin which are currently irrigated but do not meet strict arability standards. The fact that Wyoming officials have given this land a certified water right is stronger proof of irrigability that Mr. Sommers' virtually unsupported allegations to the contrary.

Secondly, Mr. Sostrom testified in the review of the adjudicated trust acres claimed by the United States, that the State's consultants, when undertaking the tract by tract analysis, did not examine the tracts or parcels on any of the photographs that had previously been questioned by Mr. Sommers. Tr. 126666, 12668. The State admits that all of the adjudicated tracts are lands that have a history of irrigation. Tr. 12886-88.

The State's consultants, in the tract by tract analysis of adjudicated land, examined aerial photographs to determine only if a parcel, in their view of the aerial photographs, was "presently

irrigated." Tr. 12666. "Presently irrigated" was defined in various ways by Mr. Sostrom. Often, he stated it meant under irrigation in 1980. However, he also stated that it really meant under irrigation on the date that the aerial photograph had been taken. In either case neither Mr. Sostrom nor the other State's consultants disagreed that each of the parcels had adjudicated water rights, a history of irrigation, or are practicably irrigable. Mr. Sostrom's testimony regarding the tract by tract analysis of the trust land having adjudicated water rights is therefore irrelevant to any issue in this lawsuit.

The State has therefore failed to overcome the prima facie case of irrigability for the 17,411 acres covered by Wyoming State adjudicated water rights. These lands are therefore entitled to a reserved right.

VIII. UNADJUDICATED IN USE LANDS

This section deals with those areas on the Wind River Indian Reservation that are currently irrigated, thus proving their irrigability and that they are practicably irrigable acreage. The basic principle underlying this portion of the United States'

presentation is that the proof is in the pudding. There can be no better proof of irrigability than actual irrigation.

The United States undertook the determination and quantification of the currently irrigated land as part of its "historic lands" program. "Historic lands" are defined as trust lands which are currently or have historically been irrigated or which can be served from historic irrigation facilities. The lands in current use are defined as those lands which are presently receiving irrigation water but do not lie within adjudicated water right service areas. United States Exhibit WRIR C-138, p. 1.

The identification of the currently irrigated lands was done under the direction and supervision of Mr. Ron Billstein of H.K.M. Associates. Mr. Billstein was one of the first expert witnesses ever to appear in this case, dating back to the initial hearings regarding adjudicated water rights in Worland, Wyoming in 1979. Mr. Billstein was qualified and accepted by the Court as an expert in water resource planning. An integral part of Mr. Billstein's professional work deals with the identification of lands that are under current irrigation. United States Exhibit WRIR C-138, Tr. 1894-2974.

The State of Wyoming also addressed the currently in use claim through the testimony of Mr. Henry Sostrom. It will become obvious after a comparison of the United States' and Wyoming's work efforts, that the United States' determination of the quantity of irrigated acreage on the Wind River Indian Reservation is far more accurate and reliable than the State's and should be used by the Special Master in his overall determination of practicably irrigable acreage.

The basic difference between the United States' and Wyoming's conclusion regarding currently irrigated acreage is the same as will become obvious throughout the other sections of this brief. Stated quite simply, it is the United States that had the more competent and qualified personnel conducting the analysis and a far more detailed and on site evaluation was performed.

The personnel at H.K.M. under the direction and control of Mr. Billstein conducted an orderly determination of the lands that were currently irrigated by first analyzing the reservation by stereoscopic photo-interpretation, supplemented by historical photographic coverage dating back as far as 1936. United States Exhibit WRIR C-138, pp. 3-6. This first tier analysis was further supplemented by color infra-red photography, assessment of previous irrigated land inventory work completed for the reservation, and review of the irrigation project assessment records that indicated the tracts upon which area farmers were currently paying money

for water delivery. United States Exhibit WRIR C-138, p. 5, Tr. 1936-37, 2143, 2150-53, 2860-65, 3151.

Upon completion of this initial screening, experienced hydrographers from H.K.M. conducted on-site inspections of all areas initially indicated as historically receiving irrigation water. A tract by tract investigation along with interviews with many actual farmers was conducted. United States Exhibit WRIR C-138, pp. 7-9, Tr. 1923-38, 1957, 2105-09, 2151, 2740-41, 2838-39, 2842-43, 2962. Additionally, Mr. Billstein and others from H.K.M. participated in work sessions with irrigation officials from the Bureau of Indian Affairs and the ditch-riders who actually conducted the water deliveries to the irrigated lands, to determine which areas were under current irrigation inside the Federal Irrigation Projects. Tr. 1923-38, 1957, 2105-09, 2151, 2740-41, 2838, 2842-43, 2962. Finally, Mr. Billstein conducted an on-site final review of the areas identified before finalyzing the acreage ultimately claimed. Tr. 2105-09.

Now let us contrast this work effort with that of the State of Wyoming. The State's effort was also conducted in a series of steps. However, in each of Wyoming's steps there was an illogical exclusion of land previously determined to be under current irrigation.

In 1980 Mr. Sostrom reviewed infra-red aerial photographs of the reservation. He concluded at that time that there were 35,860 acres of trust land on the reservation that currently were receiving water. Tr. 12618-21. This study did not include trust lands in either the Midvale Irrigation District or the LeClair Irrigation District.

Between October 1980 and January 1981, Mr. Sostrom reviewed black and white aerial photographs of the reservation. Tr. 12618. He concluded from this study that there were approximately 41,600 acres of trust land on the reservation that either currently receive or formerly had received water. Tr. 12622. Of this total, Mr. Sostrom believed that 24,700 acres of trust land currently receive water; 4,500 acres of trust land having no adjudicated water right had previously received water; 5,000 acres of adjudicated lands currently receive water; 2,800

adjudicated trust lands had previously received water; and 1,100 acres of adjudicated trust lands had "possibly previously" received water. Tr. 12623. The "currently irrigated" totals do not include two major areas of the reservation, Midvale and that portion of the Owl Creek drainage north of the main stem of South Fork Owl Creek and Owl Creek. This excludes thousands of acres of presently irrigated land. Tr. 12691-92, 13638-39.

The next step in the State's effort was initially conducted by Mr. Craig Sommers, who testified regarding various soil related topics. After a review of H.K.M.'s basic land classification data, and without any site specific field review, Mr. Sommers excluded 934.8 acres from the totals testified to by Mr. Billstein based on miscellaneous comments contained on the soil logs. Wyoming Exhibit WRIR SS-1001. This exclusion is unreasonable in that Mr. Sommers blindly relied upon data that was not designed to provide the information relevant to a determination of whether the land was receiving water and/or the type of water service connected to that particular parcel. See, Wyoming Exhibit EB-8. The question of whether these 934.8 acres

should be excluded or not comes down to the simple task of deciding which group do you believe, the group that actually visited the areas and made a finding of water service or the group that did not visit the acreage but is blindly basing their judgment on data prepared for other purposes.

Mr. Sommers excluded an additional 3,575.9 acres from the acreage totals testified to by Mr. Billstein based on non-arability. Wyoming Exhibit WRIR SS-1000. As discussed in greater detail in the "Land Classification" section of this brief, infra, Mr. Sommers is not qualified to make serious arability determinations. The specific results here are based on absolutely no field work by Mr. Sommers. Tr. 11034-35, 11127. This fact illustrates quite well the fact that the arability standards used there, which the H.K.M. standards are patterned after, are very restrictive and conservative. The arability standards are designed to predict what land will sustain irrigation and provide a high enough return to carry associated project costs such as drainage and conveyance system costs. See, "Land Classification" section, infra. When the lands are found to be currently under

irrigation, this fact must override the initial determination of non-arability. Once again, the best proof of irrigability is actual irrigation.

The most important fact to note in comparing Wyoming's step by step analysis is that land which was clearly found to be irrigated by Wyoming's initial analysis was excluded by Mr. Sommers. United States Exhibit WRIR CS-101. Tr. 12480-96. It is unreasonable to exclude irrigated land as being non-irrigable.

This brings us to the third phase of Wyoming's irrigated lands analysis. A few weeks prior to the time Mr. Sostrom testified, the State of Wyoming's consultants undertook what they called a "tract by tract analysis" of the historically irrigated acres. While this study was undertaken under Mr. Sostrom's "direction and control", Mr. Sostrom himself did not personally participate in the assessment of many tracts in this analysis (Tr. 12618) and was unable to explain the reasons why a tract may have been excluded from the final totals presented in his exhibits.

Those individuals acting under his direction or control in the tract-by-tract analysis did not visit the reservation or the historically irrigated acres to verify the opinions reached. Mr. Sostrom spent only a negligible time performing field verification work. Tr. 13066-67. The conclusions were based primarily on a review of aerial photographs. Mr. Sostrom admitted that this was not standard procedure for mapping irrigated lands. Tr. 12598. Mr. Rice, another consultant for the State of Wyoming, testified that in order to determine whether lands are receiving irrigation water, it is necessary to make field investigations and that it is not good practice to sit in the office making determinations without some basis in reality that comes from actually being on the ground. Tr. 9432-34.

The tract by tract analysis, despite its name, did not examine photographs of all of the tracts or parcels which were found to be historically irrigated by the experts who had testified on behalf of the United States. It did not include any photographs of parcels that Mr. Sommers had previously "found" to be non-arable. Mr. Sommers was not part of the team that conducted the "tract by tract" analysis. Tr. 12626.

The State's consultants, in their tract-by-tract analysis, did not review photographs of all of the tracts categorized by H.K.M. as lands currently in use but having no adjudicated water rights. Their analysis was again limited to aerial photographs of those tracts that had not been questioned by Mr. Sommers. Tr. 12690. With regard to those tracts that had been questioned by Mr. Sommers and were thus not the subject of the tract by tract analysis, one is compelled to find that no evidence has been presented by the State of Wyoming that disputes the determination of H.K.M. that all such tracts are currently in use and receiving irrigation water.

The tally of presently in use acres also excludes the so-called "circle 5" parcels. The State's consultants had originally included these parcels in their totals for presently in use land. Wyoming Exhibit HSO-2 (2d. revised). Tr. 12719-27. The lands were explicitly excluded from the final exhibit introduced by the State. Wyoming Exhibit HSO-2A. The "circle 5" lands were found to "presently irrigated" by the State's consultants who conducted the tract by tract analysis. Thus, the evidence

submitted through Mr. Sostrom supports the conclusions of the United States' experts regarding the irrigability of those tracts.

The results of the State's consultants' tract by tract analysis of "presently irrigated" trust lands were presented in Wyoming Exhibit HSO-2A. As has been noted, however, the exhibit does not purport to show all of the trust lands that are "presently irrigated" since the circle 5 land and lands excluded by Mr. Sommers were excluded from the tract by tract analysis.

Mr. Sostrom did not contend that lands that had been subjected to the tract by tract analysis and excluded from the final total of "presently in use" land on HSO-2A were not arable, irrigable or practicably irrigable. He explicitly disavowed any intention that either HSO-2A or any other of his exhibits be used by this Court as a basis of quantifying the reserved water right of the Shoshone and Arapahoe Tribes of the Wind River Indian Reservation. Tr. 13081. The reliability, relevancy and purpose of Mr. Sostrom's testimony is in doubt.

No great weight can be given to Mr. Sostrom's testimony. Mr. Sostrom was qualified by this Court as an expert in aerial photographic interpretation, based on his previous experience with the State of Wyoming Highway Department. He testified that in order to investigate whether land is irrigated one cannot rely on aerial photographs alone since the interpreter "needs to do a lot of ground truthing". Tr. 12598. Mr. Sostrom's testimony was based solely on the aerial photographs and no "ground truthing" was undertaken. Mr. Sostrom testified that he had used stereoscopic equipment in the past to assist him in interpreting aerial photographs and found it helpful. Tr. 12587. Stereoscopic equipment was not used in the tract by tract analysis. Tr. 12587.

The "tract-by-tract" analysis was primarily done by personnel other than Mr. Sostrom, although under his supervision. The previous studies were done by Mr. Sostrom himself. Tr. 12618. The Court has no idea of the expertise of the people who actually undertook the tract by tract analysis. On cross-examination Mr. Sostrom could not explain why a parcel had been excluded from the State's final totals by the reviewers without examining anew

aerial photographs of the parcel. Tr. 13013, 13033. He often disagreed with the results incorporated into the exhibits. Tr. 13015, 13037. The aerial photographs themselves conflicted with one another, according to Mr. Sostrom, and with the personal photographs taken by Mr. Sostrom. Tr. 12993, 13074, 13081-82, 13094-95. In light of this, it must be concluded that the reviewers were not qualified and were given too little instruction for their results to be raised to the degree of expert opinions. See Tr. 13000-01.

The Court cannot accept the definition of "presently irrigated" used by Mr. Sostrom as being of legal significance. Mr. Sostrom stated that the term meant "currently irrigated according to the 1980 photographs". Tr. 12747. Many of the aerial photographs were not taken in 1980. Tr. 12996-97, Tr. 13014-15. Many photos were taken before or after the agricultural season or in a separate calendar year. Tr. 13090. Others were taken after harvesting had been initiated or completed. Tr.

13024, 13125.

Counsel for the State advised the Court that the purpose of the evidence offered through Mr. Sostrom was to show that photographic interpretation is a "subjective art". Tr. 13019. This may be true, but the persons who undertook the tract by tract analysis were unskilled in the art. Further the experts for the United States did not rely on aerial photographs alone, but also made field visits to each tract they had classified as currently irrigated in use. This was followed by a comprehensive series of interviews with the water users on their representatives.

A final example of Mr. Sostrom's unreliable work product stems from the use or non-use of certain photographs which he personally took on his field visits to some of the parcels. Tr. 12998. Mr. Clear pointed out on cross-examination that a certain tract, excluded by the State as not being irrigated, was depicted in Mr. Sostrom's photographs as showing a well sustained corn

IX

LAND CLASSIFICATION FOR FUTURE PROJECT, TYPE VII AND TYPE VIII LANDS

The United States undertook a three-step program to determine the irrigability of the land that it also claimed to be "practicably irrigable acreage." That three-step process involved the determination of (1) soil arability, (2) engineering design, feasibility and costing, and (3) the determination of economic feasibility. This section will discuss the first phase regarding the arability determination made by Mr. Kersich and Mr. Waples for the five future project areas and the historic Type VII and VIII lands and Wyoming's challenge to that determination.

Wyoming's challenges to the United States' arability determination, although not well articulated, generally center around the contention that the H.K.M. study was not of sufficient intensity and that H.K.M. should not have included land that was classified as Class 4 because these are marginal lands. As we shall see below, Wyoming's challenge is not well founded because the H.K.M. study was of sufficient detail and because Wyoming's soil witnesses did not have sufficient background to challenge the work performed by the more experienced and diversified H.K.M. team.

An examination of Wyoming's soils witnesses and their credentials clearly shows that although Mr. Fowkes and Mr. Sommers had general soil science backgrounds, they were unsuited and unqualified to examine and "weigh the evidence" regarding the H.K.M. land classification/arability determination. We will deal with them in the order that they appeared at trial.

Mr. Fowkes, a former long-time employee of the Soil Conservation Service, had never engaged in the type of work that was in question prior to this case and his only agricultural-related soil work was on land that was already under irrigation. When Mr. Fowkes was attempting to discuss the reasons for the alleged failure of the Third Division, the following exchange took place:

> "THE SPECIAL MASTER: Where failures took place. Can you identify which areas had the failure?
>
> THE WITNESS: Well, I can say generally in the Third Division, the failures were seepage and alkali conditions within the areas that were irrigated because my job is working on irrigated lands after they were put under irrigation.

* * *

THE SPECIAL MASTER: What?

MR. WHITE: I'm sorry?

THE SPECIAL MASTER: I thought your job was also to make some soil analysis before the projects began, isn't that what you did?

THE WITNESS: No.
THE SPECIAL MASTER: North and west of Worland for the Wyoming Water District?

THE WITNESS: Well, yes. I thought we were talking about the Third Division.

THE SPECIAL MASTER: Then your general job will be to do the work prior as well as to observe it after.

THE WITNESS: Well, yes, this one specific job I had in the West Side."

Tr. 10614-15. (Emphasis added.)

In fact, none of Mr. Fowkes' previous Soil Conservation Service experience dealt with the determination of arability. In discussing the Soil Conservation Service land capability classes, Mr. Fowkes stated:

> A. No, we don't break them down into irrigable class in the Soil Conservation Service.
>
> The land capability class is -- we are usually -- the land capability class on this is a classification of soils for use in management for determining the limitations of the soil, and what you do with -- we are usually working on land after it's been put under irrigation.
>
> We are not in there to determine if this land is arable or not. It's already there, and if a farmer or coordinator of the Soil Conservation Service and our land capability classification spells out the degree of use that that soil can have, the limitation, the kind of treatment it has to have to sustain it under irrigation. Tr. 10657 (emphasis added).

Mr. Fowkes did conduct some work similar to a land classification on what became known as the West Side Project, near Worland, Wyoming, for the Wyoming Water Planning Program. United States Exhibit WRIR-CF-2. Although Mr. Fowkes did make some interesting findings regarding acceptable depth to barrier for irrigable soils in that report, in an attempt to disavow those findings, stated in response to cross-examination:

> BY MR. ECHOHAWK:
>
> Q. Mr. Fowkes, isn't it true that you've only done one land classification for irrigated agriculture?
>
> A. That's true.
>
> Q. That would be the West Side Project?
>
> A. Well, I'd like to qualify that.

Q. Go ahead.

A. My answer. This land classification is not in the sense of a land capability classification on irrigable lands. This is pretty much a, a soils survey that's done under the National Soils Classification System, and the classification as we used it and is in the report is the soil irrigability classification. It's just a matter of, Master, of taking this soil survey and categorizing under the criteria that was set up by the State of Wyoming, that Wyoming wanted to use this criteria for classifying their lands for the possibility of determining areas that may be able to be put under a further study for feasibility. It was sort of a, kind of an overall look kind of a classification. It's a pre-feasibility study, and we call it soil irrigable classification. It's really -- I really can't say that it's, it was a land classification.

Q. Mr. Fowkes, are you telling me then that you've never done land classification, is that what you're saying?

A. I have never done land classification as it's being spoken of in this litigation." Tr. 10679-10680 (emphasis added).

A large portion of Mr. Fowkes' testimony related to the adequacy of pre-construction soil investigations. Tr. 10609-35. Mr. Fowkes contended that the alleged failure of the Third Division

and the irrigation projects near Powell, Wyoming, were due to drainage problems. Tr. 10614, 10622. When pursued on these opinions and confronted with the transcript of his deposition, it became clear that Mr. Fowkes' opinions were unfounded and unsupportable due to his lack of knowledge on the subject.

Q. (By Mr. Echohawk) Do you recall in your deposition when I asked you about what things you were going to talk about here at trial regarding the drainage problems at Midvale, do you recall I asked you that and you said, 'Drainage is one of them. A lot of this has gone wet alkali, that's my observation from working that area. As to whether the problems developed, it's just a general statement I make, but I'm not into the drainage and that kind of stuff. I don't know anything about that, about what kind of problems you run into. And I just indicate the kind, the kind of things that I observe that causes those kind of problems and are we looking at those problems when we're basing this classification. That's the only thing I'm trying to say. I'm not saying that whether it should have been done or it was done.'

Do you recall saying that?

A. I said that."

Tr. 10724 (emphasis added).

Furthermore, when asked by the Special Master, "who would know the most about drainage problems," Mr. Fowkes responded that the person "would have to be a drainage engineer". Tr. 10557. Mr. Fowkes later stated that he was not a drainage engineer. Tr. 10721.

Wyoming's other soil related witness was Mr. Sommers. Mr. Sommers was the only witness in the trial to have the adequacy or quality of his previous work called into question. Tr. 10778-90. Mr. Sommers clearly stated that the only land classification work that he had been involved with on previous occasions was of lower intensity than the H.K.M. study. Tr. 10773. Mr. Sommers' previous work was on a reconnaissance level, while the H.K.M. study was on a modified, semi-detailed level. United States Exhibit WRIR C-43, p. 14. Since 1978 Mr. Sommers' soil related experience has involved soil surveys and mine reclamation work, which is different than land classification for irrigation development. Tr. 10780.

In the work performed for his previous employer, Mr. Sommers claims to have been saddled with materials that he was uncomfortable with and insufficient data, but yet, due to other

pressures, he used and reported the work anyway. Tr. 10778-79; 11031. In the analysis of arable lands in this case, Mr. Sommers disagreed with the H.K.M. land classification standards but used them in his analysis. Tr. 11032. Either Mr. Sommers was not that uncomfortable with the H.K.M. work or he is prone to use materials that he is told to use without regard for his own professional credibility. The United States would like to think it is the first reason.

Although Mr. Sommers challenged the United States' arability conclusions relating to soil drainability, Mr. Sommers clearly confessed that he was not a drainage engineer, had never computed any weighted hydraulic conductivity calculations prior to the trial and had never done any analysis regarding drain spacings which is an integral part to the determination of proper depth to barrier. Tr. 10782.

Thus, it is clear that the witnesses who set out to attack the United States' arability determination were two men unsuited and unqualified for the task. This is made even more apparent when the H.K.M. work program and its participants are examined.

All lands on the Wind River Indian Reservation that were determined to be arable by Mr. Kersich or Mr. Waples were classified according to site specific land classification standards. United States Exhibits WRIR C-36A, WRIR C-156. These land classification standards were developed by a multi-disciplined team at H.K.M. that was composed of agricultural engineers, a drainage engineer, and two soil scientists. Tr. 1127-29. This team utilized existing Bureau of Reclamation (hereinafter USBR) land classification data from the area as well as drawing upon their own experience that was developed from working on agricultural projects around the country to develop site specific standards for both gravity and sprinkler irrigation. Tr. 1126-32. The group continuously consulted with the USBR regarding the existing data and the development of new data. Tr. 1444.

The team at H.K.M. developed land classification standards for both large project areas as well as isolated, non-project areas. The large project standards took into consideration the necessity of the land to be able to carry the associated project costs such as drainage. Tr. 1131, 3319. The non-project standards were developed primarily for use on smaller isolated parcels in

the tributaries that would not have to carry project costs, such as large canals, pumping plants and extensive drainage systems. Furthermore, these lands would not be subject to general water table buildup from large blocks of contiguous lands. As a result, these lands could have more soil deficiencies and thus a lower level of economic return and still be arable. Tr. 3336-42. As can be seen later in the agricultural economic section of this brief, this lower productivity was considered in ascertaining economic feasibility. Contrary to Mr. Sommers' assertions at trial, both the project and the non-project standards have inherent economic considerations that allow the separation of arable from non-arable lands. Tr. 1127-29, 1171, 1430-34, 3488.

The group of land classifiers employed by H.K.M. that applied the standards in the field were very well qualified. Testimony showed that all but one of the classifiers had previous experience with the USBR doing land classification work and that three of the classifiers had between 25 and 35 years experience in land classification. Tr. 1155. This fact alone should be sufficient to resolve any dispute over proper classification of land between Wyoming's soils witnesses and those employed by the United States.

H.K.M. conducted the land classification of the future and historic lands over a three year period, utilizing the late spring, summer and early fall to conduct the field work and the remainder of the time for the office analysis. Tr. 1155, 3324. In the future project land classification the group of experienced classifiers put down 197 borings between 5 and 10 feet deep, 357 borings of 5 feet or less where conditions were limited, 9 backhoe pits and 117 deep holes of 33 feet or less. Tr. 1161-62. Eleven infiltration and 22 hydraulic conductivity tests were run on representative soil textures to obtain information on the infiltration and permeability characteristics of the soils. United States Exhibit WRIR C-43, p. 16. In order to obtain an accurate classification of the land, 927 samples from 165 holes were subjected to chemical analysis. A total of 4,401 chemical analyses were run in the future project areas. United States Exhibit WRIR C-43, pp. 20-21.

The land classification of the historic Type VII and VIII lands was performed by the same group of qualified and experienced classifiers. Tr. 3343. This group put down 224 holes in the historic project areas and 147 holes in the non-project areas. Twenty-six deep holes were utilized in the follow-up drainage program. Tr. 3323, 3552. Thirty infiltration tests

and 12 hydraulic conductivity tests were run on representative soil textures to obtain information on the infiltration and permeability characteristics of the soil. United States Exhibit C-226, pp. 10, 12. In order to obtain an accurate classification, 1,084 soil samples were analyzed in a total of 4,482 separate laboratory tests. United States Exhibit WRIR C-226, p. 13.

In addition to this field work, the land classifiers utilized a previous land classification done by USBR in the area during 1961. United States Exhibit 43, p. 16. This work was analyzed and utilized on a case-by-case basis due to certain problems that had been previously recognized by HKM and noted by the USBR. Tr. 1847-48, 3748-50. This is important to note because Mr. Sommers' analysis of the United States work did not take into consideration the fact that the USBR data was used as a supplement. Tr. 10944-45.

In conjunction with the land classification program a drainage investigation was conducted by Mr. Toedter, a highly qualified and experienced drainage engineer. Mr. Toedter was the only drainage engineer to testify in this case regarding

soil arability. Mr. Toedter utilized geological maps, pre-existing data from the Bureau of Reclamation, a deep drilling program and field testing program to determine depth to barrier and hydraulic conductivity in the areas classified. Tr. 3755.

A comparison of the Wyoming soils witnesses with the United States' team of experts makes it clear that whenever a dispute over arability arises, the presumption should always be in favor of the more experienced personnel. It has also clearly been shown that the United States had a large amount of field time and field data in addition to the 1961 USBR data to utilize as well as their on-site judgment and experience. Now let us look at the challenges that were mounted against the United States' determinations of arability.

One point of contention is whether the United States' arability determinations adequately addressed potential drainage problems. Mr. Toedter, the drainage engineer for the United States, testified that depth to barrier is essentially an economic consideration. Tr. 3738. The question being how many drains does it take to keep the water table below the desired level. Mr. Toedter undertook a detailed drain spacing analysis and consulted with the Bureau of Reclamation and determined that minimum

drain spacing could be at approximately 200 feet. Minimums for depth to barrier and hydraulic conductivity were set at 6 feet and 0.10 inches per hour respectively for arable lands. Tr. 3739-40.

Mr. Sommers, not a drainage engineer, contended that depth to barrier should be 7 feet. Tr. 10842. Mr. Sommers conducted no independent analysis to determine this figure.

As stated earlier, drain spacing is a economic consideration. How much drainage can you afford and still have a feasible project? In situations where depth to barrier was shallow and weighted hydraulic was low, extra drainage was proposed and was subsequently evaluated as being economically feasible. Tr. 11156-59.

Furthermore, cross-examinations of Mr. Fowkes clearly showed that soils he mapped as having a shallow depth to barrier of 20-40 inches in the Riverton area were under sustained irrigation. United States Exhibit WRIR CF-1, pp. 25, 26, 30; Tr. 10662-75. The only classification work that Mr. Fowkes did on lands for proposed irrigation facilities was the West Side Project. United States Exhibit WRIR CF-2. On that project he

applied standards which he helped formulate and which were approved by the Wyoming Water Planning Program of the State Engineer's Office. United States Exhibit WRIR CF-4. In discussing that work, Mr. Fowkes stated:

> Q. (By Mr. Echohawk) Isn't it true, Mr. Fowkes, that in this West Side Irrigation Project Study, you classified lands as irrigable with a depth to barrier of 20 inches?
>
> A. That's true.
>
> Tr. 10694.

Wyoming challenged the arability determinations testified to by Mr. Kersich and Mr. Waples mainly on the basis of a comparison to the 1961 USBR study in a somewhat mechanical evaluation regarding number, depth, and location of holes. Tr. 10886-96. Wyoming's analysis was essentially no analysis at all. Mr. Sommers prepared various overlay maps which depicted areas determined to be arable by H.K.M. that did not have a hole greater than 6 feet deep, no hole in the parcel, or had been previously classified as Class 6 by USBR in the 1961 gravity classification or had not been classified by them at all. Tr. 10886-97. The results of Wyoming's field program were also utilized. Tr. 10898.

Mr. Sommers generally left untouched areas where H.K.M. had holes greater than 6 feet and the USBR had previously classified it as arable. Tr. 10893. In areas where H.K.M. determined the land to be arable but where they either had no holes or no holes greater than 6 feet., and where the USBR had classified the land as Class 6 or not classified it at all, Mr. Sommers stated that there he would "weigh the evidence" to determine arability. Tr. 10893-96. This process was nothing more than determining whether H.K.M. or USBR had more holes in the parcel--the side with the most holes in the parcel won. Mr. Sommers' exclusion of arable lands with holes of less than 6 feet is unreasonable in light of the fact that even the USBR only calls for 5 feet holes in its land classification program. Wyoming Exhibit SS-A8, p. 512.2.1B. Mr. Sommers also admitted that this was the case. Tr. 11103.

In comparing the results of Mr. Sommers' field work to the H.K.M. work, very few areas of non-arable land were found. In the instances where non-arable land was found, Mr. Sommers indicated that the finding may only relate to the immediate area around his observation. Tr. 11069. Even assuming that Mr. Sommers' non-arable findings are correct, this would be within the accepted

USBR range for non-arable inclusions. United States Exhibit WRIR C-226, p. 9. In other instances, Mr. Sommers' field work verified H.K.M.'s determination of arability and refuted USBR's determination of non-arability. Tr. 11071.

Mr. Sommers stated that he was attempting to "verify" the H.K.M. results. However, in instances where there were no H.K.M. holes in the parcel or no H.K.M. holes deeper than 6 feet, Mr. Sommers would declare the parcel to be non-arable absent an arability determination by USBR. In these situations it was not that he knew the parcel to be non-arable, it was more of a case that he did not know one way or the other. Tr. 11057-59, 11125. This approach defies all reason because he failed to recognize key facts.

Mr. Sommer's approach fails to recognize the experience and judgment of the H.K.M. classifiers. Mr. Waples testified that there was no need to dig a hole in each parcel of ground when the classifier is familiar with the area and he has cut banks, roads and terrace edges to look at.

By Mr. Echohawk:

Q. Mr. Waples, talking somewhat about land classification, is it your testimony -- throughout Mr. Kersich's -- Would you please explain to us what's involved in actual land classification work, what things do you consider when you classify land?

A. Yes. This is a, kind of a complicated question, perhaps because there's more to this thing than meets the eye, there's certainly more than appears on a given log sheet, soil log.

There are two, I like to think of it as two phases really. The first of which involves a general study of the landscape. It involves study of the drainages in which you work. It involves the materials from which the soil's derived, the general topography, it's a general evaluation.

This gives the classifier, as he works throughout the area, it gives him a good knowledge of the area, it gives him an idea what to expect on a given parcel of ground before he's ever drilled a hole on it. It may not be final word, but he has a good idea of what's going on.

The second part is the actual classification of a parcel of ground, a site specific spot. In this case a field, one that was formerly irrigated or lay under a ditch. In this process -- Well, perhaps I could use just by way of example, Crow Creek on the Reservation. If I could show the Court --

THE SPECIAL MASTER: Yes, you may.

THE WITNESS: On the exhibit where this lies. Crow Creek is a tributary of the Wind River, runs from north to south roughly in the western portion of the Reservation.

I preformed classification in that drainage as well as other classifiers. The actual process of classification, as I said before, the general characteristics of the drainage are noted. In the case of Crow Creek, in many places it's deep in size, you can see how deep the soils are, you can see if there are gravels, you can see bedrock outcrops, whatever. So that's the first part of this program.

Then going to a specific tract of land to be classified, first thing that I do is make a general evaluation of that tract. I look at the slope, I see if there's any small gulleys, anything that would affect the application of water from a topographic standpoint; is the land too steep, does it need leveling, whatever.

The next part includes usually or often augering a hole on this piece of property. The hole is augered, the soil is brought up from the hole and laid out and all the important characteristics of the soil are noted; the texture, of course, the color, structure, soil parent material, whether its gravel, whether its shale, whatever. With this information, along with -- Well, then from there a sample

is taken, usually. It's sent off to the lab and the three parts of information, the topographic evaluation, the initial evaluation, the general evaluation of the drain and the soils information all go into the classification of that land as a preliminary classification. Once the lab data is back, and there's a drainage consideration, all these items go into making a final land classification determination.

Tr. 3325-28.

* * *

Q. (By Mr. Echohawk) Mr. Waples, we just finished the discussion of what things went into land classification.

Do you need to put a hole in every parcel to make an accurate land classification?

A. No, sir, not at all.

Q. Why not?

A. As we discussed when we went through the procedure of land classification, many, many things go into this: a general feel of the landscape, the more site specific feel the land classifier gains from a particular drainage, a particular landscape, often times there's other information available to that man in the field that doesn't show up on the log form -- on a log form.

There are many, many things that go into this process, and you put your holes where they will do you the most good. So if one considers -- well, the man's job in the field is to know what he's doing. That's the most important thing. There's judgment involved and, therefore, a hole is not required in every parcel.

Q. Could you make a determination of how deep the soil is if no hole is drilled?

A. There are several ways. Oftentimes, especially along the tributary drainages, there are indications of how deep the soil is through cutbanks, whatever, and also just in general, the example we used before on Crow Creek, I know that drainage very well. I know that drainage very well. I know what to expect.

There are several holes throughout that drainage up and down the drainage, and we know the area well enough to know that in most places it is --

Tr. 3329-30.

By Mr. Merrill:

Q. What other types of information did you reply upon where there were no holes?

A. Primarily such things as cut banks, road cuts. In a given drainage if the classifier is as familiar with the drainage as he should be, if he knows

the alluvial lands in which he's working, if he knows from experience in the area and from augering other holes that those lands are deep, he can make a reasonable estimation about the depth of those lands. A lot of this type work is based on judgment, it's based on a knowledge of the area, it's based on observation in the area, general observations. That's what these people are paid to do.

Tr. 3354-55.

* * *

Q. You said that you made logs of some of the cut banks and road cuts. How did you determine which cuts you were to log?

A. There again, to make a generalization, it's very difficult to say. The classifier uses what he has available. If the cuts that are in the area in which he was working are in similar types soils, similar types formations, those are the ones the classifier uses. Now, I will say perhaps to clarify this business a little bit more, most -- at least large portions of the lands that we are dealing with here -- are alluvial bottom lands. These lands certainly are not exclusively, but are typically deep soils, or at least deep enough to be arable from the standpoint of this type of study.

Q. So would it be fair to say where you had a road cut down an alluvial bottom land, you could assume there wasn't a drainage problem and no need to log such a cut?

A. If the classifier had a number of other holes in the area and was interested in classifying another small piece, a small piece in a chain of fields along a stream, if he ran into a road cut or a stream bank cut, whatever, he may not have logged that because he could make an accurate classification of that parcel without a log.

Q. Approximately how many logs did you make of cut banks or road cuts or other sources than holes?

A. I don't know. There were many more observed than there were logged.

Q. (By Mr. Merrill) Did you use any other sources other than cut banks and road cuts to supplement your hole log information ?

A. As I've stated for one thing the general knowledge of the drainage or the lands that the classifier's working in plays a significant role in this process.

Tr. 3355-59.

Mr. Sommers also ignored the fact that the USBR classification that he used was also used by H.K.M. He did not account for H.K.M.'s consideration and use of the holes from that study, or for the projection of soil depth from one hole to another within the same land form. Tr. 3330, 11116. He also failed to consider

that the USBR classification was for gravity irrigation only. Certain areas that may be classified Class 6 under gravity classification due to slope or water holding capacity would be arable under a sprinkler classification. Tr. 11109-10.

Wyoming's challenge is further based upon the contention that the HKM study was not of sufficient intensity because of the geologic setting of the reservation. Tr. 10625, 10920, 10924. It is clear that Mr. Sommers did not account for the fact that H.K.M. relied upon the 1961 USBR study in making his assessment of intensity because he compared only the number of holes that H.K.M. drilled to the USBR holes. Tr. 10945. He should have correctly counted the H.K.M. and the USBR holes together to accurately determine the intensity of the H.K.M. study.

Mr. Fowkes made a similar mistake when he called the HKM study "wholly inadequate." Tr. 10634. When pursued on this opinion during cross-examination regarding Mr. Toedter's work map (United States Exhibit C-231-A) which clearly show all of the H.K.M. and USBR holes H.K.M. relied upon, Mr. Fowkes could not give an answer. Tr. 10735. From this two things are obvious. First, Mr. Fowkes

was obviously not given all of the H.K.M. information to evaluate before reaching his harsh conclusions. Second, when he was confronted with the map that showed the numerous holes used by H.K.M. it was apparent that Mr. Fowkes had a change of heart.

Mr. Sommers pursued the Type VII and VIII lands in the same general manner. The most notable exception was that he conducted virtually no field work on these lands. He stated that he had viewed some parcels from the road when he had driven by. Tr. 11035, 11127. This cursory look with nothing more than counting holes in and outside of parcels can hardly be a basis for excluding land as being non-arable.

One additional wrinkle in Mr. Sommers' Type VII and VIII work is that he excluded all Class 4 lands. When first pursued on this approach, he stated that it was due to the fact that the land had already been determined not to be economically feasible by Mr. Dornbusch. When the Special Master found this approach not to be credible, (Tr. 10980-82), Mr. Sommers made a quick "analysis" during the lunch break and found that the lands were non-arable anyway. Tr. 10985-87; Wyoming Exhibits SS-7 Revised, SS-8 Revised. Cross-examination regarding Wyoming

Exhibit SS-7 Revised pointed out two blatant inaccuracies in Mr. Sommers' lunch time analysis, (Tr. 11146-50), thereby indicating the lack of reliability of such a study.

This exclusion of Class 4 lands is unwarranted. Mr. Sommers' reasons for exclusion were that the land is marginal and that allegedly the USBR does not now classify lands as Class 4. Mr. Sommers failed to acknowledge that the 1977 USBR Muddy Ridge land classification standards in the area allow for Class 4 lands. Wyoming Exhibit SS-10-A. Most importantly, he failed to consider that the United States' economist gave special attention to the Class 4 lands by proposing appropriate crops and accounting for the reduced returns from those lands. United States Exhibit WRIR C-278. Furthermore, Mr. Sommers did not have any data that indicated the lands were not arable.

As a result of this type of arm chair analysis which was supplemented by only 15 days of field work and 50 soil observations (Tr. 11034), Mr. Sommers excluded from the United States' arability determinations in the future project areas 22,954 acres for gravity classification and 30,321 acres for sprinkler classification. Wyoming Exhibit SS-255. Additionally, in the

Type VII and VIII areas, Mr. Sommers, with no field work, excluded 6422.8 acres from the arability determination made by Mr. Waples. Wyoming Exhibits SS-8 Revised, SS-7 Revised, Tr. 11150.

When the comprehensive land classification, drainage and laboratory program that was conducted by H.K.M., under the direction of Mr. Kersich, Mr. Waples and Mr. Toedter, is compared with the approach taken by Mr. Sommers and Mr. Fowkes, it is clear that the United States had the soundest and most technically correct approach. It is also clear that Wyoming's deletion of the large amount of acreage is not warranted because they have not shown those areas to be non-arable.

X

ENGINEERING STUDIES, WATER DUTIES AND COST ESTIMATES FOR FUTURE PROJECT LANDS, ADJUDICATED, UNADJUDICATED IN USE, TYPE VII AND VIII, AND THE OWL CREEK UNIT

A. Future Projects

The testimony regarding the design and costs of the future projects proposed by the United States was presented by Dr. Woldezion Mesghinna, a supervising engineer with the firm of Stetson Engineers, Inc., of California, where he designs irrigation systems, drainage facilities and works on hydrology problems. Tr. 4002-03.

Dr. Mesghinna was graduated from the Ethio-Swedish Institute of Building Technology in Addis Ababa in 1967. After graduation, Dr. Mesghinna worked for the Swedish International Development Authority in Ethiopia as an engineer, and later as deputy managing engineer, and was primarily involved in design and construction of school buildings and hospitals and other projects involving structual engineering. Tr. 4003-05.

Dr. Mesghinna worked for the Swedish International Development Authority for about three years. He left upon receiving a scholarship to Cornell University where he received a Bachelor of Science Degree in civil engineering in 1972. He received a fellowship from Cornell and obtained a Master's Degree in Engineering in 1973 in the field of hydraulics with a minor in geotechnical engineering, i.e., soil mechanics and foundation design. Tr. 4005.

Upon being graduated from Cornell, Dr. Mesghinna joined the engineering firm of Woodward Clyde Consultants in its eastern regional office in the New York - New Jersey area. He remained with Woodward Clyde for three years, working mainly as a hydrologist and geotechnical engineer, working on such projects as the Alaska pipeline, dam design, and flood estimation. Tr. 4006.

While at Woodward Clyde, Dr. Mesghinna decided to connect his background as a hydrologist in water resources with the problem of food production. He therefore began to specialize his expertise by studying irrigation and drainage. In 1976, Dr. Mesghinna entered the graduate school of Utah State University, studying irrigation and drainage, and received his doctorate in irrigation and drainage engineering in 1978. His doctorial dissertation was entitled "Crop Yield Prediction Under Limited Climate Data." Tr. 4007-08.

In 1978 Dr. Mesghinna joined Stetson Engineers. While with Stetson, Dr. Mesghinna has worked on designs for irrigation projects for the Salt River Indian Reservation, the Northern Cheyenne Indian Reservation, and the Warm Springs Indian Reservation. Additionally, Dr. Mesghinna has been involved in the development of reservoir systems operations in Mendocino and Sonoma Counties, California. Tr. 4010-11.

Dr. Mesghinna is a civil engineer licensed by the State of California. Tr. 4011.

Dr. Mesghinna was offered as an expert to render opinions on irrigation system designs, water and irrigation requirements, and costs. The State of Wyoming did not object to Dr. Mesghinna being allowed to testify as an expert in these fields and the Court allowed him to testify as an expert. Tr. 4014.

Dr. Mesghinna and his superior, Mr. Stetson, were the only experts in the field of irrigation system design and irrigation and water requirements that testified during the trial.[8/]

As Dr. Mesghinna testified, he was asked by the United States to design irrigation systems for the five so-called future projects: North Crowheart, South Crowheart, Big Horn Flats, Arapahoe, and Riverton East. The projects, and their

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8/ The State of Wyoming's witnesses employed other people to do this type of work. Mr. Doug Torza worked for Mr. Fassett and Mr. Rice developing the consumptive use, net irrigation and diversion requirements utilized in the "Wyoming Systems Operation Model". Messrs. Sostrom and Bishop used the services of a Mr. Steven Davidson to develop their testimony regarding consumptive use, net irrigation, and diversion requirements and to analyze Dr. Mesghinna's results and work. In addition, a Mr. James Cannon of the firm of Bookman-Edmonston reviewed Dr. Mesghinna's results and his work papers at the request of Wyoming's counsel. Neither Mr. Torza, Mr. Davidson, nor Mr. Cannon testified. Their background and qualifications are unknown.

diversion points, are described in pp. 24-32 of Dr. Mesghinna's report entitled "Conceptual Irrigation Development Plan and Irrigation Requirements, Wind River Indian Reservation, Wyoming, April, 1981", which was admitted as United Exhibit WRIR C-245. Plats showing the irrigation and drainage systems were introduced into evidence as United States Exhibits WRIR C-249-263. These projects are units of large blocks of arable trust land that have no history of irrigation. The arability of the lands in these units was determined by H.K.M. Associates acting under the direction of Mr. Kersich. The boundaries of the units were laid out by H.K.M. and, indeed, H.K.M. named the units.

Dr. Mesghinna testified on direct examination for one and a half days. The length of this testimony was due to the fact that counsel for the United States believed it was necessary to have Dr. Mesghinna explain to the Court the methodology used by Dr. Mesghinna in arriving at his conclusions. The details of his work and his conclusions are set out in his report, United States Exhibit WRIR C-245, which was admitted into evidence with the stipulation from the State of Wyoming that Dr. Mesghinna would have presented these details and conclusions orally if asked to do so. Tr. 4314.

Dr. Mesghinna explained to the Court the methodology used in designing irrigation projects. This is the eleven step program set out in volume 45 (Tr. 4019-22) of the transcript are discussed thoroughly in volumes 45, 46 and 47, which constitute his testimony on direct examination.

The experts who testified on behalf of the State of Wyoming, Mr. Bishop and Mr. Sostrom, both of Banner Associates, stated that a five man team had been employed by the State of Wyoming to review Dr. Mesghinna's design techniques to see if they were appropriate. Tr. 12152, 12209-11. Dr. Mesghinna's eleven step program was used by the Wyoming experts to review Dr. Mesghinna's results. Tr. 12159-69. The firm of Bookman-Edmonston was also employed by the State to review Dr. Mesghinna's testimony. Banner Associates' review took approximately one year. Tr. 12209. As a result of their review, Mr. Bishop concluded that Dr. Mesghinna's designs for the future projects were "reasonably good," "all right" and "supportable". Tr. 12157. Mr. Cannon of Bookman-Edmonston agreed with these conclusions. Tr. 12187. The State of Wyoming presented no alternative plans to contradict Dr. Mesghinna's results.

The first step in Dr. Mesghinna's analysis was to study the climate of the Wind River Indian Reservation. The climate data is important because from that one can determine the growing season, temperature and the amount of precipitation. It is, in Dr. Mesghinna's view, the most important factor in irrigation system design. Using data from the National Atmospheric and Oceanic Administration weather stations in the area of the reservation, Dr. Mesghinna established seven climatic zones. The lands in a zone have common climatic characteristics. Tr. 4023-41. Dr. Mesghinna illustrated the results of his study in a climatic zone map that was introduced into evidence. United States Exhibit WRIR C-244. Mr. Bishop, the State's witness, used the climate zones developed by Dr. Mesghinna for the basis of his testimony and had no disagreement with the way it was developed or with the way it was utilized. Tr. 12159. The State's witnesses apparently did not attempt an independent analysis of the climatic data on the reservation.[9/]

9/ Mr. Fassett developed other climatic data for his computer model, but Dr. Mesghinna's data, rather than Mr. Fassett's was used by the State's consultants in estimating net irrigation requirements and diversion requirements.

The next element studied by Dr. Mesghinna was the cropping pattern. As Dr. Mesghinna testified, the final decision on the appropriate cropping pattern was made by Mr. Dornbusch, an economics consultant who later testified on behalf of the United States, after considerable input and consultation with Dr. Mesghinna. Tr. 4046-65.

Dr. Mesghinna described his input into the choice of a cropping pattern. To assist Mr. Dornbusch, Dr. Mesghinna studied the Wyoming Agricultural Statistics for Fremont and Hot Springs Counties (the counties that comprise the reservation), crop data published from Midvale Irrigation District, and crop reports from the Bureau of Indian Affairs[10/] on the reservation to determine the crops that the farmers preferred to grow in the recent past (the years 1975-77). Tr. 4053. Dr. Mesghinna also studied his climatic data in order to determine if there were sufficient "heat units" throughout the reservation to grow corn. He concluded that in the higher climatic zones (above 5900 feet) the ambient temperature

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10/ The trial transcript says "B.L.M." rather than "B.I.A.", but this is an obvious error. Tr. 4045.

was such as to render the cultivation of corn a risky business, since corn needs a temperature range between 50° and 86° F during its growing season.[11/]

Dr. Mesghinna also studied the Soil Conservation Service's Technical Release No. 21, which lists the ranges of temperatures and number of growing days that each crop needs to reach maturity, in order to insure that the statistical data reporting the crops grown in the area compared with the scientific data regarding the types of crops the climate would support.

11/ As indicated, the State of Wyoming's experts accepted the climatic data developed by Dr. Mesghinna and the manner in which he utilized that data. Climate data, i.e., ambient termperature range, is a basis for Dr. Mesghinna's using 5900 feet as the division point for the cropping patterns - one with corn and one without corn. The witnesses called by the State of Wyoming testified that the division point should be 6000 feet (Testimony of Gordon Fassett, Tr. 10114) or 5500 feet (Testimony of Floyd Bishop, Tr. 13812). Both Mr. Fassett and Mr. Bishop testified that the division line they used was determined by an economics consultant employed by the State, Mr. Jim Jacobs.

Mr. Fassett's testimony was directed to demonstrating that the claims for the Indians, if granted, would have an adverse impact on the non-Indian irrigators. Mr. Bishop's testimony was intended to reduce the crop water requirements for the Indian lands. Their determination was not based on whether the ambient temperature could supply the requisite heat units required for corn. Only Dr. Mesghinna made such a study and his conclusions as to climate were accepted by the State of Wyoming's experts.

All of this information was passed on to Mr. Dornbusch who, after studying Dr. Mesghinna's data and data that he had personally uncovered and reviewed, made the determination of the crop pattern.

The cropping pattern eventually was used by Dr. Mesghinna to determine the water requirements and by Mr. Dornbusch to determine the economic returns that could be expected from the future projects.

Mr. Bishop, who testified on behalf of the State expressed some disagreement with the cropping pattern used by Dr. Mesghinna. He said that he would change the cropping pattern to reflect his view of "the way things are now being done on the reservation" (Tr. 12159) and to be "more compatible with the stock raising operations that predominate in the area". Tr. 12159. He said that he would substitute half the alfalfa in the crop pattern used by Dr. Mesghinna with grass, hay and pasture. Tr. 12160. Mr. Bishop admitted that the development of cropping patterns was outside the scope of his expertise. Tr. 12140. Counsel for the State of Wyoming advised the Court that Mr. Bishop's testimony on cropping patterns was not offered as expert testimony, but as

that of a lay witness testifying from his personal knowledge. Tr. 12160. There is nothing in the record, however, to indicate that Mr. Bishop has ever set foot on the reservation, studied any of the statistical data reviewed by Dr. Mesghinna, or is otherwise familiar with the [12/] crops grown on the reservation.

Once he had determined the climatic zones and the cropping pattern, Dr. Mesghinna set about determining "evapotranspiration", that is the amount of water consumed by the plant in the cropping pattern and evaporated from the surrounding soil. The methodology

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12/ When recalled to the stand by the State, Mr. Bishop testified that the cropping pattern used by the State in evaluating Dr. Mesghinna's future design was actually developed by Mr. Jacobs, an economist employed as a consultant by the State. Tr. 13721. Mr. Bishop stated that in lower elevations this cropping pattern was: alfalfa, 57 percent; malt barley, 18 percent; nurse barley, 14 percent; beans 11 percent. In the higher elevations the pattern was alfalfa, 71 percent; malt barley, 15 percent; nurse barley, 4 percent. Tr. 13721. (The transcript reads that in the higher elevations alfalfa constituted 17 percent of Mr. Bishop's crop pattern. Our notes from the trial indicate that Mr. Bishop said 71 percent not 17 percent. If 71 percent is used the total would equal 100 percent.) This is obviously a radically different cropping pattern than that which Mr. Bishop testified that he used when he was first on the stand. It is obvious that Mr. Bishop was confused as to the cropping pattern upon which his irrigation requirements are based.

used by Dr. Mesghinna is described in Findings 110 to 112 and supported by his testimony on direct examination and in his report. Tr. 4065-88. Mr. Bishop testified that the State's consultants basically utilized the same methodology to determine evapotranspiration.[13/] Therefore, Findings 110 to 112 are not in dispute. While Mr. Bishop would have preferred a different crop pattern, he did not dispute that Dr. Mesghinna correctly computed evapotranspiration for the cropping pattern that he used, nor did he criticize any of the analysis Dr. Mesghinna undertook as described in Findings 112 to 114. In short, Dr. Mesghinna's determination of the net irrigation requirements for the crops in his cropping pattern and described by him on pages 8-11 in Exhibit 245 are not challenged by the State of Wyoming experts.

13/ Mr. Bishop again was confused when he testified. He first stated that, rather then using the Jensen-Haise formula, (the formula used by Dr. Mesghinna to determine evapotranspiration), he had used the Blaney-Criddle formula because he was more familiar with it and because it is used in the "Wyoming Water Planning Program Report No. 5". Tr. 12163. When recalled to the stand, Mr. Bishop said the State team ". . . decided to use the Jensen-Haise formula . . . mainly because that was the formula used by Dr. Mesghinna". Tr. 13692.

Findings 105 through 120 accurately describe the next steps undertaken by Dr. Mesghinna. Again the methodology used and the results achieved were not challenged by the State. The purpose of the analysis described in these Findings is to move from the stage where the amount of irrigation water that must be delivered to the field has been determined to the initial steps in designing a system to deliver the required water and to develop the costs of such a system.

As Dr. Mesghinna testified, in order to design the on-farm irrigation system he had to determine, for each field[14/] in the proposed future projects, the intake rate, the water holding capacity and the net depth of irrigation. This was done by examining the

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14/ Dr. Mesghinna took the arable land base of the five future projects and laid out the geometric farm fields shown on United States Exhibits WRIR C-249 through WRIR C-255. Because of the shape of the fields -- required by the limitations of irrigation system's design -- some arable lands will be excluded from the field boundaries. In some instances a field may include a tiny portion of non-arable land because an engineer cannot design his irrigation system to omit these small pieces. While these pieces might not be very productive, they will of necessity have water applied to them when a sprinkler passes over them. Mr. Sostrom questioned only 16.5 acres of the entire land base of the future projects. Tr. 13421. These would be gross acres, before Dr. Mesghinna made his 5 percent reduction.

soils data -- maps and logs -- supplied to him by H.K.M. Associates and placed in evidence through Mr. Waples and Mr. Toedter.

The data supplied to him by H.K.M. and the intake rate, water holding capacity, net depth of irrigation, and effective root zone were provided to the State of Wyoming's experts (Tr. 12354), but, according to Mr. Bishop, were never reviewed by them. Tr. 12170. The State, therefore, can have no disagreements with the values thus assigned to each field by Dr. Mesghinna and there can be no dispute as to Findings 115 through 120.

The water intake rate and the water holding capacity, the effective root zone, and the net depth of irrigation determine how frequently irrigation water must be applied to the soil. Irrigation water, of course, will have to be applied most frequently during the period of peak consumptive use in the hottest month of the summer -- generally July and August. The system therefore must be designed so there are sufficient laterals to serve each field during the period of peak consumptive use; otherwise the crop could not survive the hottest part of the summer.

In order to supply the irrigation water demanded by the fields, Dr. Mesghinna designed an "on-farm" system for each field.

In all cases Dr. Mesghinna used a sprinkler system to supply water to the fields because that type of system is more efficient than a gravity system. That is, less water is wasted by use of a spinkler system than would be wasted if a gravity irrigation system were used.

Although Mr. Bishop testified that the State's team lacked enough information to evaluate Dr. Mesghinna's on-farm system (Tr. 12164), his testimony -- in light of his admission that he had not bothered to review the soils information and the intake rate and water holding capacity determinations supplied to him by Dr. Mesghinna -- is hardly credible.[15/] There would be no point in giving additional information if the State's consultants are not going to utilize the water holding capacity and intake rate of the soils which, in conjunction with the net irrigation requirement, determine the frequency of irrigation.

15/ Mr. Bishop may have meant that he did not have sufficient information to analyze the costs of Dr. Mesghinna's on-farm system. Banner Associates, however, did develop costs of $175 an acre for Dr. Mesghinna's on-farm system (Tr. 13545); Wyoming's Exhibit FSO-4A. This was based on price lists from Pierce Irrigation Corp. Tr. 13545-46. Mr. Sostrom also received a cost estimate of $163 per acre from Tom Shepard of Riverton. Tr. 13546. Mr. Sostrom could not recall why Mr. Shepard's prices were not used. Tr. 13546. The costs of $163/acre is less then the costs estimated by Dr. Mesghinna for his on-farm system.

Once he had designed the on-farm system, Dr. Mesghinna determined the efficiency for the on-farm system, or the "application efficiency" as stated in Finding No. 24. The method to determine that efficiency is set out in Dr. Mesghinna's testimony and on pp. 11-12 of his report. United States Exhibit WRIR C-245. Dr. Mesghinna testified that the application efficiency for all of the future projects was 67 percent except for the Riverton East Unit, which would have an application efficiency of 66 percent. All that the application efficiency means is that 67 percent (or in the case of Riverton East, 66 percent) of the water delivered to the on-farm laterals actually reaches the plant to satisfy its net irrigation requirement. The remaining water is lost through deep percolation, surface runoff and handling losses. In order to determine the amount of water to be delivered to the farm (or the gross irrigation requirement), one multiplies the net irrigation requirement by the inverse of the application efficiency.

Dr. Mesghinna used a computer program to determine the average application efficiency for each unit. Mr. Bishop, the expert called by the State of Wyoming, stated he had not tried to determine the on-farm efficiency, the distribution efficiency, or

the conveyance efficiency. Tr. 13724. He did not recall what Dr. Mesghinna's on-farm efficiencies were. Tr. 13724. In light of this, Dr. Mesghinna's testimony as to the on-farm efficiencies of his own proposed projects must be deemed to be uncontradicted.

Although Mr. Bishop testified that he did not have sufficient information to review Dr. Mesghinna's field designs, apparently Bookman-Edmonston felt that they had sufficient information for it approved of Dr. Mesghinna's design.

The State of Wyoming was given the length and width of each field in each of the future projects. The width of each field is the length of each lateral. As noted in the report, the sprinklers on each lateral are 40 feet apart. The water pressure at each sprinkler was given to the State (55 p.s.i.). Tr. 4187. The net depth of irrigation, the intake rate, and the water holding capacity were provided to the State. The soils information upon which Dr. Mesghinna relied was introduced into evidence and provided to the State; Mr. Bishop, however, testified that he had not bothered to review the soils information. As noted above, the State experts did not disagree with the net irrigation requirements developed by Dr. Mesghinna for his crops and had no dispute with his application efficiency.

Once he had designed the on-farm delivery system, Dr. Mesghinna designed a pipeline network to deliver the water from proposed canals to the farm laterals as set out in Findings No. 121 . The distribution system is made up entirely of enclosed, buried pipe and therefore has a high efficiency since there is little water lost through evaporation or through seepage into the soil. Dr. Mesghinna assigned an efficiency of 95 percent to the pipe distribution system in each of the future projects. That means that 5 percent of the water leaving the canals will be lost prior to its reaching the farm laterals. In other words, 105 percent of the water that is required to reach the farm laterals must leave the canals. The pipe network distribution system has a very high efficiency and no witness for the State of Wyoming disagreed with the efficiency postulated by Dr. Mesghinna. Mr. Bishop, again, testified that he had not examined Dr. Mesghinna's distribution efficiency.

The hydraulic design of the pipe distribution system is based on the Hazen-Williams which is set out on pp. 19 and 20 of Dr. Mesghinna's report, United States Exhibit WRIR C-245. By use

of this formula, Dr. Mesghinna was able to determine the length and diameter of each segment of pipe in the distribution system.[16]/

Dr. Mesghinna then designed pumps and pumping plants at the intersections of the pipeline network with the canals. Finding No. 122 . The only controversy associated with the pumping plants was the question of costs, with the tribes arguing that Dr. Mesghinna's costs were too high. Dr. Mesghinna admitted throughout his testimony, however, that his costs for pumps and pumping plants were on the high side.[17]/ Dr. Mesghinna then designed canals to transport water

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16/ As with the on-farm system, Mr. Bishop testified that he did not have enough detailed information to really make a good analysis of the pipeline network. It appears from the record, however, that the only matter relative to the pipeline network that he felt he could not adequately evaluate was the costs. Tr. 12164. However, Mr. Sostrom testified that Banner Associates had developed costs for the pipeline network that were considerably lower than Dr. Mesghinna's. Tr. 13493-503. On Wyoming's Exhibit FSO-4, however, the State's consultant's adopted Dr. Mesghinna's pipeline costs as their own (Tr. 13503) because, Mr. Sostrom, a Mr. Ruff and Mr. Bishop decided that Dr. Mesghinna's pipeline costs were "very reasonable". Tr. 13501.

17/ Mr. Sostrom, the State's consultant, estimated that the costs for Dr. Mesghinna's pumps and pumping plants, would be lower than estimated by Dr. Mesghinna (Tr. 13663-64).

from the diversion points on the rivers and streams to the pumping plants. These are canals designed for all projects except Big Horn Flats and some acreage within the Riverton East project.[18]/ The conveyance efficiencies for the canals was determined by use of the Moritz formula.

The witnesses testifying on behalf of the State of Wyoming did not express any disagreement with the canal or conveyance efficiencies utilized by Dr. Mesghinna. Dr. Mesghinna's canals are not lined and their efficiency is therefore determined by the characteristics of the soil through which the canals are to be dug. As we have noted, the State's consultants did not study the soils information used by Dr. Mesghinna and given to the State's consultants by Dr. Mesghinna.

When Mr. Bishop testified about efficiencies, he subtracted 10 percent from Dr. Mesghinna's overall efficiency on the ground that Dr. Mesghinna's canal efficiencies did not include the 10 percent

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18/ Dr. Mesghinna testified that he increased his costs estimates for the canals by 10 percent to cover unforeseen contingencies. Tr. 13484.

figure for operational waste. Tr. 12774. Therefore, in Mr. Bishop's view, Dr. Mesghinna's total overall efficiency (on-farm efficiency multiplied by distribution efficiency multiplied by conveyance efficiency) was around 35 percent. Dr. Mesghinna's overall efficiencies in fact range between 45 percent and 48 percent. From these figures, Mr. Bishop subtracted Dr. Mesghinna's figure for operational waste, on the theory that Dr. Mesghinna had not included operation wastes in his conveyance efficiency determinations. See Tr. 12774. However, Dr. Mesghinna clearly testified that his operational losses were calculated in his canal efficiencies.

The conveyance efficiency is merely the ratio of the amount of water delivered to the pumps to the amount diverted from the source. Tr. 4234. Implicitly, therefore, operational waste would be included in the conveyance efficiency. Dr. Mesghinna explicitly stated that his conveyance efficiencies include operational waste. Tr. 4238.

Because he had erroneously believed that Dr. Mesghinna's overall efficiency was 35 percent rather than 45-48 percent, Mr. Bishop believed that, using an overall efficiency of 50

percent, he could decrease the diversion requirement by 15 percent. Actually, of course, the best his higher efficiency could do would be to lessen the diversion requirement by 2-5 percent. As Mr. Sostrom testified, a very large factor in Mr. Bishop's belief that the "future projects" could obtain a 50 percent efficiency was the fact that Banner Associates advocated lining the canals. Tr. 13539-40. Mr. Sostrom believed that lining the canals would reduce the total diversion requirements for all future projects by 40,000 acre feet. The cost of lining the canals would be $5,460,430 according to the figures in Wyoming Exhibit WRIR FSO-4C. Tr. 13540. There are 53,760 net acres in Dr. Mesghinna's future projects. Table 24, United States Exhibit WRIR C-245. Thus, the costs of lining the canals would approximate $100 an acre.

As noted above, Mr. Bishop believed, erroneously, that Dr. Mesghinna's future projects were designed to achieve only a 35 percent overall efficiency. The alleged reduction in the diversion requirement of 40,000 acre feet therefore represents a difference between the 35 percent efficiency and the 50 percent efficiency.[19/]

19/ Dr. Mesghinna's total diversion requirement for all the future projects is 209,372 acre feet of water. A reduction of 40,000 acre feet is a reduction somewhat over 15 percent.

Lining the canals would not reduce the net irrigation requirement of the crops or increase the distribution or the on-farm efficiencies. All that would be saved would be the water that would be lost through seepage through the soil of unlined canals. Most of this water would return as return flow to the river system and would be available to other water users. Even if we assume that 35 percent of the seepage loss fails to return to the stream system, the total annual water savings would be only 14,000 acre feet of water. That means that it would cost around $315 per acre foot of water saved to line the canals.

It must be remembered that Dr. Mesghinna's final designs as presented by him to the Court were the culmination not only of his efforts but also the efforts of the economic consultant employed by the United States, Mr. Dornbusch. In some cases -- most notably Big Horn Flats, Dr. Mesghinna had designed irrigation facilities to serve lands in addition to the tracts included within his final acreage totals. However, Mr. Dornbusch had advised Dr. Mesghinna that the anticipated returns from these lands did not justify the costs per acre, as estimated by Dr. Mesghinna. Dr. Mesghinna

therefore excluded these acres from his final totals. These omitted lands appear in the design plans for Big Horn Flats submitted with Dr. Mesghinna's report; however, the tracts included in Dr. Mesghinna's totals found in his report are circled in black. 20/

The ultimate conclusions of Dr. Mesghinna were the water requirements for the future projects as set out in Findings Nos. 129 through 134. Mr. Bishop proposed alternative water duties for some of the future project lands, i.e. those lands that the State consultants believe to be arable. In our view, any reliance by this Court on Mr. Bishop's testimony would be unwarranted.

It must be remembered that the water duties and consumptive use figures used by the State of Wyoming were developed by Mr. Sostrom or Mr. Davidson and not by Mr. Bishop. Mr. Sostrom was not qualified to render an expert opinion on water duties and

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20/ The Tribes maintain that Dr. Mesghinna's costs -- particularly those for the pumping plants and the drainage systems are too high and that if these costs were reduced (thereby reducing the costs per acre of the projects) these lands could be economically irrigated.

his role as an expert was limited to two areas: design and construction of roads through irrigation systems and photographic interpretation. Tr. 12610. Mr. Sostrom was specifically prohibited from testifying about water duties by this Court. It was therefore necessary for the State of Wyoming to bring Mr. Bishop back to testify about water duties for the future projects.

Unfortunately, the defect was not cured by calling Mr. Bishop. Mr. Bishop did not determine the water duties even though he testified about them. The water duties were calculated by Mr. Sostrom (see Wyoming Exhibit HSO-1) and merely put into evidence by Mr. Bishop. Mr. Bishop was not expressing his expert opinion, he was expressing the opinion of Mr. Sostrom whom this Court found not to be an expert in the field of irrigation requirements.

It was painfully evident from Mr. Bishop's testimony that he did not understand how crop water requirements are determined or how they had been determined by Mr. Sostrom.

As we have noted already, Mr. Bishop gave conflicting stories on what cropping pattern had been used by the State. He said that the State had used the Blaney-Criddle method for determining the consumptive use of water by the crops and taken the figures used out of "Wyoming Planning Program Report No. 5". He said that by using Blaney-Criddle, the State had reduced the consumptive use requirement for alfalfa by 10 percent per year. He felt that by using the first cropping pattern he testified about and by using "Water Planning Report No. 5", there would be a 3-5 percent decrease in the net irrigation requirement and a decrease of 30 percent in the diversion requirement.[21/]

When he returned to the stand he changed his story: a new cropping pattern came into being -- this one chosen by the economists, Dr. Jacobs. Mr. Bishop stated that they had now used the "Jensen-Haise" method to determine the water requirements. He stated that they had used a 50 percent overall efficiency for the future projects because that was the efficiency of the Goshen Irrigation Project and the Kendrick Project. Mr. Sostrom, however, in response to the direct question from the court stated that the reason that Mr. Bishop used a 50 percent overall efficiency was that the Banner team plan called for lining the canals.

21/ Again, this was based on his erroneous assumption that Dr. Mesghinna's overall efficiency was 35 percent.

It should be noted, however, that the net irrigation requirement proposed by Mr. Bishop for the future lands does not differ significantly from that proposed by Dr. Mesghinna.

The main area where the State's consultants disagreed with the testimony of Dr. Mesghinna was in the area of costs, and that the greatest area of disagreement was over the costs of engineering and contingencies.

Banner Associates, for whom both Mr. Sostrom and Mr. Bishop are employed, are not in the business of designing or constructing irrigation projects of facilities. Tr. 12605-06, 13472. Much of the disagreement they had with Dr. Mesghinna arose from their alleged lack of information regarding Dr. Mesghinna's designs, but in view of the fact that they do not design irrigation systems, one must wonder what usefulness more information would have served them.

In the one area where Mr. Sostrom had expertise, he reaffirmed Dr. Mesghinna's cost and discarded the cost estimates prepared by Banner Associates. As this Court no doubt will recall, Mr. Sostrom, in his work as an engineer for the Highway Department of the State of Wyoming had designed distribution systems for

irrigation systems in order to replace those that would be disrupted when highways were constructed. Mr. Sostrom had never designed an on-farm irrigation system, a canal system, or a drainage system, but he had designed the distribution system from the canals to the farms. He had done this in the past because the highways built by the State Highway Department often disturbed existing distribution systems for irrigated farms and the Highway Department, in any effort to keep the goodwill of the citizenry would design and apparently construct a new distribution system that avoided the intrusion of the highway.

Thus, some deference to Mr. Sostrom is due when he rejects costs developed by Banner Associates for the pipeline distribution system and uses the costs formulated by Dr. Mesghinna. It shows that Sostrom, when he was operating in familiar territory, recognized that Dr. Mesghinna had done a better job in estimating costs than had the members of the Banner team. Tr. 13501-03.

When Mr. Sostrom wandered outside of his area of experience, however, he was very unsure of himself, his excuse being an alleged lack of information. His testimony regarding engineering fees and

contingency expenses, for example, shows his lack of confidence in his own figures. Indeed, he relied upon not the figures he developed, but upon the advice of others.

Mr. Sostrom justified his high engineering (20 percent) and contingencies estimate by citing to his experience as an engineer with the State of Wyoming Highway Department, because the irrigation projects are similar in nature to highways. Tr. 13457. However, the Westside Irrigation Project study introduced through Mr. Fowkes (United States Exhibit CF-1), showed that it is common practice to estimate engineering and contingency expenses at a total of 20 percent of the investment costs. Tr. 13457-61.

Mr. Sostrom further testified that his 20 percent figure for engineering fees includes costs of soils investigations, studies and tests, land surveys on boundaries, expert witness fees in litigation, assistance to clients at public hearings, costs for determining operation and maintenance charges, costs for interpreting climatic data, costs for determining net irrigation requirement and crop consumptive use. Tr. 13466-68. These services have already been completed by Dr. Mesghinna. Mr. Sostrom also admitted

that the costs that the United States has incurred in defending his lawsuit, initiated by the State of Wyoming, were assessed by him against the project itself as engineering costs. Tr. 13468. He further admitted that the ASCE guide says that 40 percent of the engineering costs are incurred during the preliminary design phase - that is the phase completed by Dr. Mesghinna. Tr. 13471. Forty per cent of twenty per cent is eight percent, thus leaving a remainder of twelve per cent that can be charged to engineering.

Mr. Sostrom's reliance on a Mr. Keppler of his office or on Mr. Bishop for his engineering and contingency fees is misplaced. Banner Associates does not design or construct irrigation projects. Tr. 13472. The fee proposed by Mr. Sostrom was not compared to engineering fees on any other irrigation project. Tr. 13472.

It is, of course, the simplest matter to allege that a cost assessed on a per centage basis is too low and that that cost should be significantly increased. However, where, as here, the State's consultants are not experienced in design or construciton of irrigation works, they must come up with some reason other than the practices of the State Highway Department or something someone told them at a seminar. Stetson Engineers does design irrigation

systems, their work has been adopted wholesale by the State consultants, and their testimony as to what costs are assessed for engineering and contingencies in their field and by their company must be given great credibility.

Mr. Sostrom testified that the State estimates for capital investment cost of the future projects and Type VIII land should be increased by 41 percent for engineering fees (20 percent), contingencies (15 percent) and "mobilization and bonding" (6 percent). Tr. 13554. But as Dr. Mesghinna testified, his projects are designed ". . . beyond any doubt to anyone who is going to give money for loans or anything for the project. And in that way I am including such costs that are not included there such as mobilization by the contractor, such as certain contingencies or insurance or something of this sort, have been included in the costs here" (i.e., in the investment costs itself). Tr. 12386. Dr. Mesghinna again reiterated that his investment costs estimates are very high because the costs estimates include "mobilization and contingencies." Tr. 12403. Dr. Mesghinna explained in answer to a question from Mr. Perry that his capital or investment costs are high because the projects are designed to include unforeseen events, so that

mobilization costs and contingencies are not "outside" costs but are included in the costs of equipment itself. Tr. 12415. Thus, in the distribution pipe network design, the cost estimate was increased five percent. Tr. 12415. His costs, Dr. Mesghinna stated, reflect "exactly what is needed or more than what is required." Tr. 12416.

In Dr. Mesghinna's view, design of an irrigation system is a comparatively simple engineering problem. Tr. 12417. His unit costs are conservative, based on what has been done in Wyoming previously. Tr. 12417. He thus could lower his engineering and contingency figure to 20 percent -- which he increased to 25 percent to be on the safe side. Tr. 12417. Further unlike the costs for engineering that Mr. Sostrom testified advocated, Dr. Mesghinna's figure includes only the costs for further engineering studies that may be necessary. Tr. 4873. Quite properly, Dr. Mesghinna did not include in his costs the expenses incurred by the United States as a result of this litigation.

We would note that Dr. Mesghinna's system is designed to conserve water. His plans therefore call for sprinkler irrigation at the farm level rather than flood irrigation, which is less

efficient but cheaper. His designs require a buried pipe network distribution system that achieves a 95 percent efficiency. As he testified on cross-examination he could have designed an open ditch distribution system that is less costly but less efficient. If we compare the efficiency of the systems he designed (approximately 50 percent) with the historic efficiency (approximately 35 percent), we easily see the reduction in the total diversion requirement achieved by his design.

There is no rule of law that requires this Court to limit "practically irrigable acres" to lands that can be economically irrigated by a sprinkler irrigation only or by a system that incorporates a buried pipeline distribution network. Quibbling with the costs of the system designed by Dr. Mesghinna therefore does not reduce the amount of practicably irrigable acres since the costs can be greatly reduced -- and the diversion requirements greatly enhanced -- by removing sprinklers, buried pipes, and portions of the pumping plants from the designs. Thus would also greatly reduce any engineering or contingency fees.

Finally, we call the Court's attention to the fact that counsel for Wyoming, apparently recognizing the weakness in the

background of Mr. Bishop and Mr. Sostrom, hired another consultant, Bookman-Edmonston to review Dr. Mesghinna's work. This firm, according to Mr. Bishop, ". . . concluded that they could design a project similar to those designed by Dr. Mesghinna for about the same costs". Tr. 12189.

B. Adjudicated, Unadjudicated in Use, and Type VII Lands

Thomas Stetson, the president of Stetson Engineers, Inc., testified on behalf of the United States regarding the water requirements for the historic lands. Mr. Stetson is a registered civil engineer, licensed by the State of California. Tr. 5209.

Since 1950, when Mr. Stetson went to work as an assistant civil engineer with the Division of Water Resources for the State of California, he has worked in areas of engineering that require soils classification, determination of irrigable areas, consumptive use studies, efficency studies, and determinations of amounts of water that could be used in a geographic area for present and future purposes. He has completed such studies for Lake County, California (1950); Ventura County, California (1953); San Luis Obispo County, California, San Diego County, California.

In 1955, Mr. Stetson transferred to the Colorado River Board of California as supervising hydraulic engineer to prepare the State of California's case in Arizona v. California. In 1957, Mr. Stetson left State employment and founded Stetson Engineers, Inc.

Mr. Stetson currently is a consultant to the Attorney General of the State of California with regard to the water rights case entitled Arizona v. California. He is a consultant to the

City of Bakersfield, California. He is District Engineer for the San Ynez River in Santa Barbara County and for the San Gabriel Valley Municipal Water District.

In the past, he represented the Dos Palmas Irrigation District and did a study for that district to develop about 8,000 acres of land for irrigation. Stetson Engineers was involved in the construction of the Sausalito Irrigation District project. That project, like the ones proposed by Dr. Mesghinna, takes water from a canal and pumps it through a closed pipe distribution system to the on farm system.

Mr. Stetson serves as a consultant on water rights matters to the City of Ventura, the City of Glendora, the City of Los Angeles, and the State of California (in addition to his work on behalf of the State in Arizona v. California). Mr. Stetson had testified as an expert witness before. Tr. 5209-18.

Mr. Stetson was offered as an expert witness to testify regarding the water duties for the historic lands. Tr. 5218. The Court permitted him to so testify. Tr. 5221.

Mr. Stetson presented testimony regarding the water duties of the trust lands that had a history of irrigation -- that is they are currently irrigated, have State adjudicated water rights, or were irrigated in the past (Type VII lands). The identification, categorization, and location of adjudicatd lands, currently irrigated

lands and arable Type VII lands was the responsibility of H.K.M. Associates and testimony regarding these matters was presented by Mr. Waples and Mr. Billstein of that firm.

Since Mr. Stetson's testimony dealt with lands that have a history of irrigation, his task was somewhat simpler than Dr. Mesghinna. With respect to lands within the Wind River Irrigation Project or within Midvale or LeClair Irrigation Districts, Mr. Stetson examined the records of the project to calculate the number of acres (Indian and non-Indian) served by each unit in the project and the annual diversions for that unit. He then divided the diversion by the number of acres in the unit and thus obtained the average diversion requirement for each acre of irrigated unit, expressed in terms of acre feet of water diverted per acre of land irrigated in the unit.[22/] Finally, Mr. Stetson multiplied the average diversion requirement by the number of trust acres in each category (adjudicated, currently in use, and Type VII) to determine the total diversion requirement for each category in each unit of the Wind River Irrigation Project and in Midvale and LeClair. Tr. 5228-30. Using this method, the figures set out in proposed Findings Nos. 139 through 158 were derived. No witness for the State critized this methodology or the results achieved.

22/ These diversion requirements developed by Mr. Stetson were used by the State's witness Mr. Fassett in developing his model. Tr. 10289-90, 10319-20.

Findings No. 160 accurately describes the methods used by Mr. Stetson to determine the average efficiency of the irrigation projects, including the Midvale and LeClair Districts. Once he had the average diversion requirement, he determined the net irrigation requirement for each unit in the unit; eventually he would determine the overall efficiency of a project by dividing the net irrigation requirement by the average diversion requirement. His procedure is set out in detail on pp. 5236-41 of the trial transcript.

In order to determine the net irrigation requirement, he had to use the same methodology as Dr. Mesghinna. He used the same climate data developed by Dr. Mesghinna (as did everyone else in the lawsuit). He used the climate zone data and map that Dr. Mesghinna had developed. His cropping pattern was different than that used by Dr. Mesghinna since Mr. Stetson's cropping pattern is based on what has been grown historically on the reservation whereas Dr. Mesghinna's cropping pattern was developed in conjunction with the economist in order to determine which mix of available crops would bring the best economic return. Tr. 5236, 5268.

Mr. Stetson's cropping patterns were based on crop records for Fremont and Hot Springs Counties, the BIA irrigation project and Midvale Irrigation District. Tr. 5270-71.

Once he had the climate data and the cropping pattern, Mr. Stetson used the Jensen-Haise formula to determine the net

irrigation requirement for the historic lands within the irrigation project unit. Mr. Stetson then determined the overall efficiency of each project unit by dividing the per acre net irrigation requirement of a a unit by the diversion requirement and multiplying by 100. Tr. 5237.

Once he had the determined the overall efficiency for each unit, Mr. Stetson determined the overall average efficiency for all the units. In determining the overall average efficiency, Mr. Stetson excluded consideration of the Upper Wind Unit because historically the average diversion requirement for Upper Wind has been extremely high and its use in calculating the overall average efficiency would bias the results, tending to make the project appear less efficient than it really is.

Mr. Stetson calculated that the overall average efficiency of the project is 34.7 percent, so he used 35 percent as his overall efficiency. Mr. Bishop agreed that 35 percent was the overall efficiency for the historic lands. Tr. 12152, 12196, 12214.

Finding No. 161 describes the methodology used by Mr. Stetson to determine the diversion requirement for the historically irrigated lands outside the boundaries of the irrigation project. This methodology was not challenged by the State's experts. Finding Nos. 162 through 221 describe these lands (excluding Type VII lands) and their diversion requirements.

Type VII lands are discussed in Findings Nos. 224 through 264 , which are the Findings for the Type VII lands both within and without irrigation project boundaries. The water duties for the Type VII lands within a project unit were determined in the same manner as were the water duties for the adjudicated and unadjudicated in use lands within a unit. The water duties for the Type VII lands outside irrigation project boundaries were calculated in the same way that the water duties were fixed for the adjudicated and unadjudicated in use lands outside irrigation project boundaries.

The Type VII lands are arable lands that do not have an adjudicated water right and are not currently receiving water but do have a history of irrigation. In order to bring them back into production, some expenditure of money will have to be made. Mr. Stetson, through inspection of each tract of Type VII land, determined the amount of money that would have to be spent to bring each parcel to the point where it could be currently irrigated. Tr. 5255. He then passed this information on to Mr. Dornbusch who calculated anticipated economic returns. The testimony of Mr. Stetson regarding Type VII water duties involves only those Type VII lands where the anticipated economic returns equal or outweigh the estimated costs of putting the land back into production. Tr. 5257-58.

Costs were developed on the assumption that the Type VII lands would be fully irrigated. Tr. 5256. Costs included the costs of such items as diversion headworks, canal extensions or enlargements, turnouts, head ditches on the farm if required, pumps and pumping costs, and annual operation, maintenance and energy costs. Tr. 5256. Wyoming Exhibit WRIR ES-15. The costs were developed for the year 1979. Tr. 5523. Costs include land levelling for farm sites that would use gravity irrigation. Tr. 5529-30.

In determining water duties, Mr. Stetson did not differentiate between parcels on the basis of types. While he did distinguish parcels on the basis of the climatic zones, net irrigation requirements and efficiencies, water requirements were not decreased merely because a parcel was a Type IV, V, or VI rather than a Type I, II, or III. As Dr. Mesghinna explained to the Court, water requirements are determined primarily by the climate and the cropping pattern. A particular crop in a particular climatic zone requires the same amount of water on a Type V parcel as it does on a Type I parcel. Mr. Bishop, when he testified, confused water requirements of the crop with water supply and based his conclusions on requirements on an alleged lack of supply.

Mr. Bishop testified that, on behalf of the State of Wyoming, he had evaluated Mr. Stetson's testimony regarding the historic lands. Tr. 12152, 12196, 12214.

Mr. Bishop agreed with Mr. Stetson that the current overall efficiency of the historically irrigated lands is 35 percent. Tr. 13718. Mr. Bishop stated, however, that he would have used a 50 percent efficiency when he determined water duties. Tr. 12197, 13718-19. Mr. Bishop expressed no disagreement with Mr. Stetson's figures for the efficiencies for each of the individual project areas, did not challenge the records that Mr. Stetson used to come up with his annual diversions for each project unit the acres served by each project unit, or the average per acre diversion requirement of each project unit.

Mr. Bishop said that he had reviewed Mr. Stetson's cost estimates for rehabilitating the Type VII lands. He stated that "in a large sense" his team had used the costs developed by Mr. Stetson but that his cost estimates were somewhat higher than Mr. Stetson because he made increases in the costs estimates for "structures" [23/] and "added" land levelling costs. Tr. 12196. Mr. Stetson, of course, testified that, based on his on site review of each tract of Type VII land, he had included costs estimates for land levelling.

Mr. Bishop also told us that Bookman-Edmonston had reviewed Mr. Stetson's work, but he did not tell us what Bookman-Edmonston's conclusion were with respect to the historic land. Tr. 12214.

23/ Mr. Sostrom later testified that the State consultants did not change any of Mr. Bishop's costs for Type VIII land. Tr. 12629.

Mr. Bishop testified that, in estimating the crop water requirements for the State of Wyoming's historic land base, the State's consultants had used the same cropping pattern as had been used by Mr. Stetson (Tr. 13720, 13730), the same climatic zone (Tr. 13715), and the modified Jensen-Haise formula that was utilized by Mr. Stetson (Tr. 13693). He stated that they felt that the net irrigation requirement was somewhat higher than that calculated by Mr. Stetson.

Mr. Bishop's testimony regarding water duties of the historic lands did not include all the historic lands testified to by Mr. Stetson. Mr. Bishop's testimony was limited to those lands which ended up on the "tract-by-tract" exhibits introduced through Mr. Sostrom.[24/] Thus for the vast majority of the historic lands for which Mr. Stetson had determined water duties, the testimony of Mr. Stetson is unchallenged and unimpeached. With respect to the lands classified as currently in use by Mr. Sostrom and identified on Wyoming Exhibit HSO-2A, HSO-3, and HSO-9, the State's consultants initially assigned net irrigation requirement on the basis of whether a tract is Type I, II, or III, a Type IV or VI, or a Type V. A further division was made based on whether a tract lay in a water short drainage or not.

24/ As we noted earlier in this brief and in our proposed findings, Mr. Sostrom stated that the results of the Wyoming "tract-by-tract" analysis, and the exhibits relating to that analysis, should not be relied upon for determining water requirements for trust lands.

thus 50 percent reduction of the net irrigation requirement for Type IV land because it is in a water short drainage is a double reduction. More fundamentally in error, however, is his explanation of how the 30 percent figure for Type IV and Type VI lands was derived. Mr. Bishop stated that he assumed that in any given year only 30 percent of lands in a water short area would receive water. Tr. 13736-37. Therefore, he said, he had assigned only 30 percent of the net irrigation requirements to those lands on the assumption that only 30 percent of the Type IV and VI lands be actually irrigated. But it must be remembered, as Mr. Bishop did not, that all of the lands listed on HSO-2A are lands that Mr. Sostrom contends were all receiving water in 1980. That is, all of the Type IV and Type VI land on that exhibit received water in 1980. If Mr. Bishop's assumption that only 30 percent of the Type IV and VI land receive water in a given year is correct, those 30 percent are reported on Wyoming Exhibit HSO-2A. The remaining 70 percent of those types of land would not show up at all on Wyoming Exhibit HSO-2A. In sum, the 70 percent reduction would have already been made by Mr. Sostrom by the time Mr. Bishop got around to determining water requirement and thus no water duties were assigned to those lands. Mr. Bishop therefore should have assigned a full net irrigation requirement for the Type IV and VI land on Wyoming Exhibit HSO-2A because according to Mr. Sostrom they were receiving water in 1980.

If a tract is a Type I, II, or III, and is within a non-water short drainage, Mr. Bishop testified that its net irrigation requirement was determined by using Dr. Mesghinna's climatic data, the cropping pattern developed by Mr. Stetson, and the Jensen-Haise formula. Tr. 13692-93. If a tract is Type IV or VI land, it was assigned a net irrigation requirement of only .3 of what it would have received if it were a Type I, II, or III parcel. Tr. 13694. If a parcel is a Type V it was assigned a zero net irrigation requirement. Tr. 13694. When determining the net irrigation requirement for lands in a water short drainage, the State's consultants assumed that the tract would received no water after July 15 and therefore reduced the net irrigation requirement by approximately one-half. Tr. 13694.

As Mr. Bishop testified on cross-examination, under his methodology a parcel of Type IV or VI land in a water short drainage receives only about .15 of its net irrigation requirement. This is so because Type IV and VI land were assigned only 30 percent of their full net irrigation requirement in the first instance, and then that was reduced in half by assuming no water delivery after July 15 in each year. Tr. 13731-35.

Mr. Bishop's entire approach in determining net irrigation requirements is faulty. In the first place Type IV lands are lands which by definition are generally in water short drainages;

Instead Mr. Bishop gave them only .3 of their requirement, in effect assigning .09 of the net irrigation requirement to Type IV and VI. Similarly, by assigning a zero net irrigation requirement to Type V land appearing on Wyoming Exhibit HSO-2A, Mr. Bishop again ignored the fact that Mr. Sostrom testified that these lands were receiving water in 1980. It must be remembered that Type V land is land that uses water for and supports a crop and that that crop, like all crops on the reservation, has an irrigation requirement since effective precipitation is insufficient to support a crop.

In effect Mr. Bishop was taking 30 percent of the Type IV and VI land, assigning it only 30 percent of the land's net irrigation requirement and then reducing that irrigation requirement still further by terminating irrigation every year halfway through the irrigation season. This means that Mr. Bishop's irrigation requirements supply only 4.5 percent of the water that these lands require. 25/

25/ We do not deny that Type I, II or III land has a better chance of receiving a full supply of water than Type IV or VI land. However, this has nothing to do with crop water requirements. It does of course affect the economic returns that one can anticipate from a parcel of land, and Mr. Dornbusch testified that he did reduce anticipated yields on Type IV and VI lands.

In regard to his determination of net irrigation requirements for Type I, II or III land, Mr. Bishop's technique is equally faulty. If Mr. Bishop believed that such lands were in water short drainages, he assumed that their net irrigation requirement would be cut approximately in half by shuting off water on July 15 of each year. By definition, however, Type I, II, and III lands are lands that historically have received all the water they need -- they are designated as full service lands even if in a water short drainage.

When we consider the methods used by the State in assigning water duties for the Type VII lands, the problem is compounded. As both Mr. Sostrom and Mr. Bishop testified, in determining the net irrigation requirements for Type VII land, the State's consultants initially determined how many acres of the various land types appeared on Wyoming Exhibit HSO-2A, i.e., among their schedule of presently irrigated lands. They found that 64 percent were Type I, II, III, 22 percent were Type IV, and 14 percent were Type V. Tr. 13695. Mr. Bishop then assigned this same ratio to the lands which the State agreed were Type VII and assumed that if irrigation were restored to these lands, 64 percent would be assigned of a full net irrigation requirement, 22 percent would receive .3 of the full net irrigation requirement and 14 percent would receive a zero net irrigation requirement. These figures were then averaged to come up with a "consolidated

average crop irrigation demand" for Type VII land. This consolidated average was then applied to all Type VII lands in non-water short drainages. Tr. 13696. In water short drainages, the State's consultants, as stated above, assumed that all irrigation would terminate on July 15.

The use of the "consolidated average crop irrigation demand" means that no Type VII land is assigned the full net irrigation requirement devised by Mr. Bishop.

Once he had estimated the net irrigation requirement for each tract, Mr. Bishop multiplied the requirement by 2 to derive his estimate for the diversion requirement. This is based on his belief that a 50 percent efficiency is achievable.

According to Mr. Bishop, canal lining, installation of a pipe distribution sytem and use of sprinkler irrigation, rather than flood irrigation, would be necessary in order to achieve the 50 percent efficiency for the historic lands. Tr. 13725-26. This of course would increase the costs to such a point where the State consultants would declare that irrigating the historic lands, including those currently receiving water, is economically infeasible. Mr. Sostrom estimated that the costs of lining half the canals would be over $5,000,000 and this figure did not include a pipe distribution sytem.

For his full service lands in non-water short drainages therefore, Mr. Bishop's unit diversion requirement is only 3.03 acre feet per acre. Tr. 13793. Type VII lands, using the "consolidated average crop water demand" developed are given a unit diversion requirement of only 2.4 acre feet per acre. Tr. 13797.

Mr. Stetson's diversion requirements for the River Irrigation Project (other than the exceptional Upper Wind Unit) ranges from 4.94 acre feet per acre in the Coolidge Unit to 6.94 acre feet per acre in the Lefthand Unit. For the non-project historic lands, Mr. Stetson's lowest unit diversion requirement is 4.94 acre feet per acre and the highest is 5.94 acre feet per acre. Wyoming Exhibit WRIR HS-3,4,5. Mr. Sostrom's review of historically irrigated trust land showed a unit diversion requirement of 7.45 acre feet per acre. Tr. 13800, United States Exhibit WRIR HSO-H.

In the hearings at Worland, individual farmers and ranchers who currently irrigate testified regarding their diversion requirement. These witnesses were not called to testify on behalf of the United States and, indeed, they may be said to be adverse parties. James Longfellow, who farms on the reservation testified that his diversion requirement is between 5 and 6 acre feet per acre per year. Tr. 13522W. Lowell Lund, a retired farmer and a commissioner for LeClair Irrigation District testified that even in 1977, which all agree was an extremely dry year, the unit

diversions for LeClair were 4.37 acre feet per acre. Tr. 13625W. Jack Long, the manager of Midvale Irrigation District testified that in 1981 Midvale diverted 453,420 acre feet of water to irrigate 67,827 acres of land. Tr. 13647W-49W. This is a unit diversion requirement of 6.67 acre feet per acre. In 1978 the unit diversion requirement for Midvale was 4.77 acre feet per acre. Tr. 13735W. Thus, the average unit diversion requirement for 1978 and 1981 was 5.72 acre feet per acre.

Mr. Lund testified that in LeClair 3.05 acre feet of water per acre must reach the farm site. Mr. Long said that in Midvale 3.15 acre feet per acre must reach the farm. Mr. Gideon Davis, a commissioner of the Riverton Valley Irrigation District said that, in that district, 3.5 acre feet of water per acre must reach the farm. Mr. Bruce Murray testified that in the Wildwood Division of the Shoshone Irrigation Project, 5.29 acre feet of water per acre is delivered to the farm and that, in the driest year (1977), 3.19 acre feet per acre were delivered. Tr. 14314-15, 14323. Mr. Chester Zwemer testified that on farm deliveries in the Deaver Irrigation District ranged from a low of 2.84 acre feet per acre in a very dry year (1977) to 4.27 acre feet per acre in 1980. Tr 14333. All of the above figures are the requirements for water that must be delivered to the farm. That is they equal the unit diversion requirement less the conveyance losses and the distribution losses. Even if one were to line

all the canals and install a pipe distribution system, these requirements for water delivered to the farmsteads would not be reduced. It is noteworthy that in all cases, except in 1977 in the Deaver Irrigation District, the requirements of water to be delivered to the farm exceed the diversion requirements that Mr. Bishop proposed, even for Type I, II, or III lands in full service areas. One can only conclude that even if the canals were lined and a pipe distribution system were installed (i.e., even if the efficiency was increased), Mr. Bishop's diversion requirements are still unrealistic.

The farmers and irrigation officials who testified in Worland all repudiated Mr. Bishop's theory that land can be consistantly irrigated if it receives only 30 percent of its net irrigation requirement or has its supply shut off every year on July 15. See Testimony of William Hamilton. Tr. 13484W, Testimony of Lowell Lund (Tr. 13614W, 13622W), Testimony of Gideon Davis (Tr. 13764W, 13781W, 13784W), Testimony of William Daniels (Tr. 13797W-99W, 13804W, 13805W), Testimony of Carl Duane Rush (Tr. 13816W), Testimony of Matt Brown (Tr. 13853, 13865). This demonstrates that Mr. Bishop's theories regarding water duties for Type IV and Type VI land and in water short drainages fall far short of reality. Many of the witnesses who testified in Worland farmed in water short drainages and many irrigated past July 15. For example Carl Duane Rush diverts from Owl Creek and Mud Creek,

both water short drainages. He showed the Court two photographs taken in August -- one of a tract that received water only in the early spring and the other that had received water in August. The difference in the fields was not due to lack of water supply, but was based on the difference in the priority dates of the water rights relevant to each field. If he had had a better priority date for the first field, Mr. Rush testified he would irrigte it in August. Tr. 13815.

Thus, Mr. Bishop has confused water requirements with water supply and with the priority date of a water right. The effect of Mr. Bishop's assigning less than full water duties to Type IV, V, VI, VII lands and lands in water short drainages in reality changes the priority date of the right as shown by the testimony of Mr. Rush. This is further demonstrated by a comparison of the testimony of Mr. Langford Keith with the testimony of Mr. Maurice Allen, both of whom irrigate from the Owl Creek drainage. Mr. Keith has territorial water rights that date back as far as 1882 and his latest water right has a priority date of 1915. Tr. 14082. He used his water to cultivate hay for his cattle operation (Tr. 14086) and he produces enough hay to provide winter feed for his cattle and therefore can run a cow-yearling operation. Tr. 14086. Mr. Allen's State water rights have priority dates of 1909, 1910, and 1935, that is, they have a much lower priority date than Mr. Keith's. Tr. 14124. Mr. Keith,

because of his lower priority, can get only two cuttings of hay even in a good year. Tr. 14121. If he received no water in July, August or September he would get only one cutting of hay. Two cuttings of hay do not allow him to harvest sufficient crops to supply winter feed for his cows and he thus runs a cow-calf operation rather than a cow-yearling operation. Unlike Mr. Keith's operation, Mr. Allen's operation is not self-sufficient. Tr. 14120-21. Mr. Allen testified that if he had a priority of 1868, he would move ahead of Mr. Keith's priority and be able to get three cuttings of hay. Tr. 14124. This testimony amply demonstrates that to limit an Indian water right in a water short drainage so that no water after July 15 can be delivered would inherently assign to the land a water right with a late priority date -- a priority date not only later then Mr. Keith's territorial priority dates but also later than Mr. Allen's 1935 date.

C. Type VIII and the Owl Creek Unit

The testimony regarding the engineering and costs of development of the Type VIII lands and the Owl Creek future units was presented by Dr. Mesghinna on May 14, and 15, 1981, and is found in Volumes 63 and 64 of the transcript. Dr. Mesghinna's conclusions are also set out in United States Exhibit WRIR C-277. Detailed data regarding Dr. Mesghinna's plans and cost estimates are in evidence as Wyoming Exhibits WRIR FM-8A-11 through 15, 100 through 118, 200 and 209.

Dr. Mesghinna determined the diversion requirements for Type VIII lands and the Owl Creek project in generally the same manner as he determined the diversion requirements for the future projects. Tr. 5582. The costs were also determined in the same manner as Dr. Mesghinna determined the costs for the future projects (Tr. 5582-83) but there are no canal costs involved in the development of the Type VIII lands and there is a small ditch rather than a canal is proposed for the Owl Creek Unit. Tr. 5583. All Type VIII lands are within the Wind River Irrigation Project. Tr. 5582.

Projects were designed and costs determined only for lands classified by H.K.M. as Class 1-3 lands. Tr. 5589.

In the analysis of Dr. Mesghinna's testimony regarding Type VIII lands, Mr. Sostrom, Wyoming's consultant, adopted the acreage used by Dr. Mesghinna. Tr. 13424. Mr. Bishop testified for the State that he computed the net irrigation requirement in the same manner that he had computed the net irrigation requirement for the "historic lands". Tr. 13705. Apparently for the Type VIII lands he used the "consolidated crop irrigation demand" that he developed for Type VII lands. We have discussed the problems with Mr. Bishop's methodology in the portion of this brief relating to Mr. Stetson's testimony and adopt that discussion therein.

V. AGRICULTURAL ECONOMICS REGARDING FUTURE PROJECTS-TYPES VII AND VIII, UNADJUDICATED IN USE LAND

The following discussion will show that the United States' economist, Mr. Dornbusch, performed a well-founded and reasonable economic analysis on the acreage claimed by the United States. We will further show that Wyoming's analysis, performed by Mr. Jacobs, does not attempt to present a fair or reasonable view of the situation, but is, instead, designed to make the claimed acreage fail economically. This is demonstrated by Mr. Jacobs' consistent choice and use of data that minimizes the benefits and maximizes the costs even when he was presented with reliable data to the contrary.

The United States, the Tribes and the State of Wyoming all performed economic feasibility analyses on the proposed irrigation developments on the Wind River Indian Reservation. Mr. Dornbusch, the economist for the United States, evaluated the economic feasibility of the acreage proposed and discussed by Dr. Mesghinna, Mr. Stetson and Mr. Billstein. Those areas are known as the future projects (North Crowheart, South Crowheart, Big Horn Flats, Arapahoe and Riverton East), the Type VII and VIII[26/] lands, and the unadjudicated in-use lands. Dr. Ron Cummings, the Tribes' economist, evaluated the future projects plus two additional areas (Stagner Ridge and Big Horn Flats extension) but with costs presented by Mr. Bleisner, the Tribes' agricultural engineer. The State of Wyoming's economist, Mr. Jacobs, evaluated

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26/ As used in this section "Type VIII lands" includes the Owl Creek future project lands.

all areas except for the unadjudicated in-use areas, using a combination of Mesghinna, Stetson, Bleisner, and Sostrom costs. All three economists utilized an economic rather than a financial analysis approach, which views the projects from a national perspective and evaluates them in the same way that any other projects of that kind would be evaluated anywhere in the United States. Tr. 4933, 4937.

Economic feasibility was evaluated by Mr. Dornbusch by comparing the present value of the expected stream of future benefits to the present value of the expected stream of future costs, using a discount rate that was appropriate for this type of analysis. Projects or areas were declared to be feasible where the benefit cost ratio was greater than or equal to 1.0. Tr. 5046-49.

Future benefits were estimated by determining the crops that could reasonably be expected to be grown in the area, estimating the expected yields, multiplying those yields by the expected prices for the crops and by then subtracting on-farm irrigation costs to determine the net returns by project area. Tr. 4940-41, United States Exhibits WRIR C-267, WRIR C-268.

Irrigation system costs were primarily obtained from Stetson Engineers. Some additional cost items were obtained from reliable sources to include all development costs. Tr. 5024-32. An example of these other costs is that of land preparation which was obtained in consultation with the Bureau of Reclamation office in Billings, Montana and from the Soil Conservation Service. Tr. 5027-30.

CROPS AND YIELDS

There was generally no real dispute between the economists as to the crops that could be grown in the area or the yields that could be derived from those crops. Two major areas of dispute that did arise regarding crops and yields were: (1) the elevation break-point that should be used to divide the differences in crop yields which reflect the reduction in growing season, and (2) the appropriate yield to use in the analysis for malt barley at both the high and low elevations.

On both points of disagreement the United States and the State of Wyoming relied upon published reports and interviews. The disagreements arose as a result of the persons interviewed and interpretations of the information.

Whenever there was a reasonable question as to the data, Mr. Jacobs consistently chose to ignore the data which would indicate higher yields or greater economic returns. An example of Mr. Jacobs' approach is found in the farmer interview results. Although he was aware of Mr. Dornbusch's interview results which showed that farmers in the highland area were currently getting malt barley yields much higher than those reflected in the publications, and regardless of the results of the State's interviews that showed the serious farmers, not the ranchers, were also getting malt barley yields at or greater than 100 bushels to the acre, Mr. Jacobs chose to rely on averages. Tr. 14937-40.

Let us briefly examine the data from the various interviews conducted by the parties. United States Exhibits WRIR-JJ-7, WRIR-JJ-8, WRIR-JJ-9, WRIR-JJ-10; Wyoming Exhibit ED-16. The interviews conducted by Mr. Jacobs indicate that the even some ranchers attained yields of 95-100 bushels per acre for barley. United States Exhibits WRIR-JJ-7, WRIR-JJ-8, WRIR-JJ-9, Tr. 14929-34. The interviews conducted by Mr. Sommers for the State of Wyoming showed that Mr. Larson was getting 80-100 bushels of barley per acre, Mr. Rohn was getting 95, Mr. Rein was getting 90-115, and that Mr. Fike was getting 100 bushels of barley per acre in the highland area. United States Exhibit WRIR-JJ-10, Tr. 14937-40. Mr. Dornbusch's interviews showed seven farmers achieving barley yields at or in excess of 100 bushels per acre on the Wind River Indian Reservation. Wyoming Exhibit ED-16.

Mr. Jacobs instead used averages from both the interviews which included ranchers and the published material reflecting yields from the area farms which include Class 4 and 6 lands. It was made very clear in the testimony at Worland that large amounts of acreage in Midvale alone are Class 4 and 6. Tr. 13729W-30W. Mr. Jacobs stated that if yields to be considered did not have Class 4 or 6 soils in them, the yields should be higher than those he used, an important point since the acreage claimed by the United States only has insignificant amounts of Class 4 or 6 soils. Tr. 14946-47.

Furthermore, Wyoming's own witness, Mr. Carver, also verified that ranchers were not as conscientious when it came to farming, thereby accounting for the lower yields shown in the rancher interviews. Tr. 11973-75, 11979-80. Thus, the pattern was beginning to form whereby Mr. Jacobs would ignore credible data when it would favor the economic feasibility of the United States' claimed acreage and opt for less desirable data.

Mr. Dornbusch, on the other hand, conducted interviews of the farmers on the reservation and found that not only did farmers obtain yields in excess of 100 bushels of malt barley, but also found that the yields were not greatly reduced by the increase in elevation. Wyoming Exhibit ED-16. He had obtained interviews that stated it was indeed possible to grow corn, a generally short season crop, above 6,000 feet. elevation but that the only reason it was not being grown was due to labor problems. Tr. 4949. In the face of this farmer interview information, Mr. Dornbusch also had to consider the information from the other people he consulted such as Agricultural Extension agents who indicated that a reduction in yield would take place in the higher elevations. Mr. Dornbusch chose the conservative approach and opted for a ten percent reduction in yields above 5,900 feet. elevation and did not include corn in the crop mix above 5,900 feet. Tr. 4957.[27/]

27/ Mr. Dornbusch was also supported by Dr. Mesghinna's study on "heat units" required for growing corn above 5900 feet. Dr. Mesghinna determined that there were sufficient "heat units" for that purpose thus verifying Mr. Dornbusch's conservative elevation split. See, Engineering, etc., section of this brief, supra.

Mr. Dornbusch's approach of using yields reflecting the yields of above average farmers is consistent with the recent Special Master's findings in Arizona v. California, supra. There, Special Master Tuttle, in addressing the proper yields to use in analyzing practicably irrigable acreage, stated in regard to the United States' economist:

> I am also convinced that his overall theoretical approach is the most sound as well. His decision to emphasize the yields of the better farmers was consistent with economic theory. As the only true economist to testify, this expert provided the most convincing evidence upon which I can base a judgment regarding whether his use of the better yields and high-level management is consistent with a proper economic inquiry. I should note, however, that his conclusions accord with what I consider to be the sensible approach, because the present inquiry concerns the ability of the lands to produce crops profitably, not the likelihood of any particular person, average or otherwise, to succeed in such an operation. If the land can profitably be farmed by anyone, considering all relevant costs and benefits, the land might beneficially be irrigated.
>
> For these reasons, I find the approach and application of the United States to be the preferable method regarding projected yields and would adopt its findings. (Footnote omitted.) Arizona v. California, United States Supreme Court, No. 8, Original, Elbert P. Tuttle, Special Master, Report, p. 141.

Mr. Dornbusch also used the "sensible approach" in upgrading the barley yields to reflect what the farmers in the area could obtain. He also accounted for increased management and fertilizer costs to achieve those yields. Tr. 4991. Thus, Mr. Jacobs' "Good Management" projections must be disregarded. Wyoming Exhibit EJ-3, pp. 23, 24, 32, EJ-4, pp. 2, 7, 8, 16, 18, 19.

This brings us to the controversy regarding the proper elevation at which to reduce the crop yields due to a shorter growing season. As stated earlier, Mr. Dornbusch conducted farmer interviews in the highland area that indicated that a reduction in yields for crops grown on the reservation above 5,900 feet may not even be necessary. He chose, however, to heed the advice of other credible sources and reduce them. In addition to considering the farmer interviews, Mr. Dornbusch relied on the Wind River Completion Report, prepared by the Bureau of Indian Affairs, certainly a credible source that was not prepared for litigation. Tr. 4948-49, 5389-5843.

Mr. Jacobs, on the other hand, once again chose to ignore the credible evidence and relied upon data which he did not attempt to verify, the result of which was to reduce yields and therefore returns in the project areas. The information which Mr. Jacobs did not verify was a preliminary report prepared by other United States' consultants, H.K.M Associates, who were reviewing the prospective study areas in which they would ultimately conduct their land classification analyses to determine arability. Wyoming Exhibit ED-15. Mr. Jacobs did not know who authored the H.K.M. document and did not attempt to check whether any economist was involved in the preparation of that document. Tr. 14907-08. The only reasonable explanation of why he would use such a document is to again penalize the analysis. Mr. Jacobs also chose to ignore the farmer interview information that he had, which was obtained by the State and the United States, which clearly showed

that a yield reduction was not appropriate at the 5,500 feet elevation that he used.

The State of Wyoming belatedly attempted to buttress this obviously unsupportable 5,500 feet elevation break by calling Doug Agee to testify. Mr. Agee attempted to support Mr. Jacobs' use of the 5,500 feet breakpoint with a publication regarding growing degree days (Wyoming Exhibit EA-3). Exhibit EA-3 indicates, on page 1, paragraph 4, that:

> Growing degree days requirements for various varieties of corn, small grains, and other crops are not completely established. Most work has been done on corn, with hybrid corn maturities now commonly being labeled in terms of growing degree day requirements. Requirements generally range from nearly 2,000 to almost 3,500 degree days, depending on the variety and location.

Page 2 of EA-3 also indicates that the preferred method to be used in calculating the growing degree days for corn is the "modified method". Although Mr. Agee agreed with the report, he incorrectly used the degree days reported in the "50 F" columns instead of the modified equation columns. Tr. 15318-19.

According to the tables in EA-3, pages 5, 7, 12, 13, 15 and 16, the towns at elevations between 5,500 and 5,900 ft. show sufficient degree days to grow corn, thus substantiating Mr. Dornbusch's use of corn in that elevation range. Furthermore, Mr. Agee did not base his opinion of the 5,500 feet split on any farmer interviews. It was brought out on cross-examination that

although Mr. Agee had done substantial field work in the area in preparing his Riverton area crop reports (Wyoming Exhibit ED-8), he had not interviewed anyone above 5,500 feet. Tr. 15390-91. Thus, Mr. Dornbusch is the only witness that used reliable information upon which to make the elevation determination.

One additional point of difference regarding the crop yields was that Mr. Jacobs chose to reduce the yields obtained from the crops during the first five years to account for a start-up period. He used five years despite the advice he received on the subject which indicated that only two years should be used. Tr. 14953. Mr. Dornbusch chose to handle the question of early productivity a different way, that is by increasing the production and land preparation costs at the beginning of the irrigation project to account for the additional fertilization and land preparation costs needed to attain full yields. This was done on the advice of the Bureau of Reclamation. Tr. 6133-34.

INPUT COSTS - LABOR AND EQUIPMENT

Another area of disagreement between Mr. Dornbusch and Mr. Jacobs was in the area of farm labor costs, that is, the amount of the labor costs that should properly be assessed at zero opportunity costs. The opportunity cost of an item is valued by its next best use. Tr. 4985-86. There was no disagreement between Mr. Dornbusch and Mr. Jacobs over the economic principle of costing a portion of the labor at a zero opportunity cost when a portion of that labor would come from the ranks of the unemployed Indians on the Wind River Indian Reservation.

Tr. 14829. The dispute is over the appropriate proportion to cost at zero.

Mr. Dornbusch conducted a study to determine the level of unemployment on the Wind River Indian Reservation in the past and also as to the prospect of any future employment opportunities. He also questioned the appropriate officials and found that the young Indians desired to stay on the reservation and that they had the desire to work. Tr. 4988-89, 5934-42. As a result of the investigation, Mr. Dornbusch found that, apart from the proposed irrigated projects, the reservation offered no reasonable expectation of employing the large expected unemployed labor force, and that the expected unemployed labor force was large enough to accommodate the labor needs of the projects. Tr. 4987. As a result of his investigations, Mr. Dornbusch made a professional judgment that it was proper to cost 20 percent of the labor at full cost and 80 percent at zero. Tr. 4987.

Mr. Jacobs, on the other hand, made no attempt to determine long range unemployment on the reservation or the possibility of future employment for those unemployed Indians. Tr. 14978. He did not even attempt to consult a fellow employee of Wyoming Research Corporation who had conducted such an analysis. Tr. 14832.

The next area of disagreement regarding the input costs deals with the cost of farm equipment and machinery and how the cost of such is allocated on a per acre cost over the life of the project. Mr. Jacobs and Mr. Dornbusch both agree as to the

particular pieces of equipment to be used. United States Exhibits WRIR C-268, WRIR C-278, Wyoming Exhibits EJ-3, EJ-4, EJ-14, EJ-15.

The first point of disagreement in this area between Mr. Dornbusch and Mr. Jacobs is over the price for each piece of farm equipment. Wyoming's own witness, Mr. Agee, in his earlier work in the Riverton area (Wyoming Exhibit ED-8), computed equipment prices for 1977. Mr. Agee's prices were based on interviews with dealers in the immediate vicinity of the Wind River Reservation. Tr. 15376-79. These are the prices that Mr. Dornbusch used after indexing them by appropriate means to 1979. Tr. 4974-4985.

On the other hand, Mr. Jacobs, where possible, chose other prices that were much higher. He stated that he used USDA average prices when he could but used Mr. Agee's prices (indexed) when he could not find the USDA price. Tr. 14894. It was pointed out quite clearly, using United States Exhibit WRIR-JJ-5, that had Mr. Jacobs consistently used Mr. Agee's prices that were applicable to the area, it would have resulted in substantially lower equipment costs and therefore lower production costs.

> THE WITNESS: I think I also explained that there were certain items, equipment that we could not find in the USDA publications, and I'd have to go back and see whether that's a coincidence, but there are a few items that we couldn't find in that, and so we went back to Agee's price and indexed it up.
>
> MR. ECHOHAWK: Okay. Fine.
>
> Q. (By Mr. Echohawk) Let's find out which ones those are, and then we can use those as the proper example.

> Can you find out from whatever information you need to find it out what pieces of equipment --
>
> THE SPECIAL MASTER: Sure, I bet they are the last six; is that right?
>
> Q. (By Mr. Echohawk) The last six --
>
> THE SPECIAL MASTER: The last five, the side rake, the bean cutter, the rod weeder, and the sprayer, and I'll bet you those are what you used because they came out identical to the dollar, and that happened to be the only figures on the exhibit that came out to the dollar.
>
> THE WITNESS: The side-rake would be one. The bale stacker is another. The bean cutter and the rod weeder and the sprayer.
>
> THE SPECIAL MASTER: All right, thank you.
>
> Next question.
>
> Q. (By Mr. Echohawk) Okay. Now, for those last items that you just mentioned, when you indexed Agee's prices, the results are shown in Column 4, is that right?
>
> A. Yes.
>
> Q. Now, using that same indexing method that is illustrated in Column 3 and applying that to your other equipment prices, isn't the result that had you continued to index all of Agee's prices by your indices, the results would have been the equipment prices coming out substantially lower than what you used in your analysis?
>
> A. If you compare those, yes, there are some higher, there are some that are fairly close.
>
> Tr. 14897-99.

In using United States Exhibit WRIR-JJ-5 and comparing the cost differences between the indexed USDA prices that Mr.

[illegible] used and the prices he would have calculated [using his two indices] had he consistently used Mr. Agee's more representative area prices, we see that Mr. Jacobs' prices are too high by the following dollar amounts and percentages:

Pickup Truck	$1,327	19.5 percent
Truck, Box & Hoist	$3,940	29.4 percent
2-Wheel Tractor (125 hp)	$5,897	21.2 percent
2-Wheel Tractor (80 hp)	$2,252	14.9 percent
Harrow	$1,358	30.0 percent
Disk Tender	$ 226	5.0 percent
Grain Drill	$ 635	16.7 percent
Seed & Corn Planter	$1,583	49.2 percent
Cultivator	$1,068	56.0 percent
Rotary Hoe	$ 176	7.4 percent
Baler, PTO, Twine	$1,720	27.2 percent

Mr. Jacobs' high equipment prices were further illustrated by comparing the tractor prices used in his analysis with those contained in "The National Farm Tractor & Implement Blue Book, 1981." United States Exhibit WRIR-JJ-4. This comparison shows that Mr. Jacobs' prices for the three types of tractors, which are the most expensive and most utilized pieces of equipment, were 22 to 35 percent higher than blue book prices (using the most expensive blue book prices) and 50 to 91 percent higher than blue book prices, using the least expensive blue book prices for the respective items. Tr. 14883-93, United States Exhibit [illegible].

The second major point of disagreement concerning input costs is the allocation of the cost of a particular piece of equipment on a per acre basis. This issue essentially amounts to determining the efficiency of the equipment use or the farm size for which a complete complement of equipment will be required.

Mr. Dornbusch approached this issue by determining an efficient use of machinery and equipment, recognizing that the development projects could be managed as tribal enterprises or as independent farms with a cooperative management of equipment. Tr. 4980981. Both scenarios increase returns per acre by reducing costs per acre. This arrangement is certainly reasonable in view of the governmental nature of the Tribes and because the Tribes or individual Indian are not constrained by the 160-acre limitation that arises out of United States reclamation law. Mr. Dornbusch determined the most efficient equipment use by relying on a study conducted by the Bureau of Reclamation on the Hardin Bench in Montana. That study showed that the most efficient farm size is 2,560 acres. Tr. 4980, United States Exhibit WRIR DA-1.

Mr. Jacobs, on the other hand, did not attempt to determine the most efficient farm size. Tr. 14875. He merely used a farm size of 320 acres because that is what Mr. Agee used in his previous analysis of farm land around the Riverton Reclamation Project. Tr. 14848. Mr. Jacobs' use of the 320 acre farm size results in dividing the future project area of approximately 53,000 acres into approximately 165 small farms. Using Mr. Dornbusch's 2,560 acre farm size, the same area would be divided into 21 farm units. Where Mr. Dornbusch would have purchased 21 complements of farm equipment, Mr. Jacobs would have purchased 165 such complements. The effect on associated equipment costs are self-evident.

Mr. Jacobs acknowledged the fact that many pieces of equipment would be used very little on each 320 acre farm. Tr. 14844, United States Exhibit WRIR-JJ-1. Mr. Jacobs continued with this approach despite the fact that Wyoming's other agricultural economist, Mr. Agee, acknowledged that many of the pieces of equipment could be used efficiently 5 to 10 times as many hours as it would be on a 320 acre farm if there were no acreage limitations imposed. Tr. 15380-88. Mr. Agee's testimony in this case and his previous work regarding the economics of farm size around the Worland area show that per acre fixed costs are less on larger farms. United States Exhibit CF-3, p. 7. The result of such underutilization of equipment is to raise the fixed cost allocation per acre to very high levels.

When the inefficient use of the farm equipment is coupled with the abnormally high equipment prices used by Mr. Jacobs, the result is extremely high fixed costs and therefore production costs. Wyoming's fixed costs are more than three times the fixed costs per acre for barley and more than four times the fixed costs per acre for alfalfa estimated by Mr. Dornbusch. Wyoming Exhibit EA-10. These two crops account for most of the lowland acreage and all of the highland acreage in the crop mix used by the United States. United States Exhibits WRIR-C-268, p. 11, WRIR-C-278, pp. 14, 36, 37. This amazing statistic only goes to show the incredulity of Mr. Jacobs' approach and analysis. Since the fixed costs are a large portion of the total farm operation costs, this factor distorts all of Wyoming's crop budgets and is significant in producing low benefit cost ratios.

DISCOUNT RATE

The next major area of dispute between Dr. Brookshire on the one hand and Mr. Dornbusch, Dr. Goldfeld and Dr. Cummings on the other, is the question of the proper discount rate to apply in the analyses. A discount rate is used to determine the present value of the 100 year stream of costs and returns associated with the projects. All four economists were in agreement that the proper rate to be used was a "real" discount rate, that is, one which is net of expected inflation, since all parties projected costs and returns which were also net of inflation. The two United States economists and Dr. Brookshire for Wyoming also generally agreed that the opportunity cost approach was relevant in determining the actual rate to apply. Dr. Goldfeld, for the United States, focused on two aspects of opportunity cost -- that of capital displaced from investment and capital displaced from consumption -- to arrive at his conclusions. Tr. 15492-94. Dr. Brookshire mentioned the opportunity cost of consumption and social time preference in Wyoming Exhibit EB-3 but made no use of them. The matter in dispute was the actual number or range of numbers that should be used in the discounting process.

Dr. Steven Goldfeld was called as the only United States' rebuttal witness to address the issue of the proper discount rate to apply and address Dr. Brookshire's testimony. Dr. Goldfeld was certainly the most qualified of all economic witnesses to discuss the issue of discount rates. Dr. Goldfeld's

experience as a member of President Carter's Council of Economic Advisors, 10 year consultant to the Federal Reserve, Professor and Chairman of the Economics Department at Princeton University, makes his testimony very enlightening and extremely credible and reliable.

The two United States' economists and the Tribes' economist were in close agreement as to the proper range of discount rates to apply. Mr. Dornbusch determined 2-4 percent (Tr. 5044), Dr. Goldfeld determined 1-4 percent (Tr. 15517-18), and Dr. Cummings determined 2-4 percent to be the appropriate range, (Tr. 2877-78), although Dr. Cummings felt that possibly discounting was not appropriate at all in this situation. Wyoming's economist, Dr. Brookshire, chose a very high and wide range of rates — 4 to 11 percent. Tr. 14525-27.

Let us evaluate Dr. Brookshire's obviously different range of rates and see why they are not appropriate. As the basis for Dr. Brookshire's analysis he chose an article entitled "Rates of Return by Industrial Sector in the United States, 1948-76" by Barbara M. Fraumeni and Dale W. Jorgenson (Tribes Exhibit DB-1). This article was described as a "respected" and "sound" piece of work by Dr. Goldfeld. Tr. 15498. It is how that document is used that presents the problems in Dr. Brookshire's work. The Fraumeni and Jorgenson article presents average rates of return for the various industrial sectors of the economy. On the third page of Tribes Exhibit DB-1 or page 328 of the article, right hand column, second full paragraph,

Fraumeni and Jorgenson present what is described as the "aggregate own-rate of return for the period 1948-76" which is 0.0478 or 4.78 percent. This is the same as the weighted average real rate of return for all sectors (Tr. 15502) and the primary reason for Dr. Brookshire's disagreement with the United States' and Tribes' economists was his disregard of this aggregate rate.

Had Dr. Brookshire chosen to use this summary presented in the article he would have been close to the appropriate rate. However, for unsound reasons he chose to ignore this summary figure presented by the authors and chose to make up his own summary by using a range based upon irrelevant mathematical averages. Tr. 15551-59. Dr. Goldfeld clearly showed why Dr. Brookshire's range was improper and characterized his method as a "beauty contest" and stated that the proper consideration was to weight each sector by the amount of capital within each sector, precisely the method used by Fraumeni and Jorgenson to determine the weighted average. Tr. 15557.

After Dr. Goldfeld established that Dr. Brookshire should have used the 4.78 percent summary figure from Tribes Exhibit DB-1, he showed three reasons why that figure should be reduced. They were first, revisions in the basic data underlying the Fraumeni and Jorgenson study, second, Dr. Brookshire's failure to consider the critical concept of marginal rates of return instead of average rates of return and third, the current bi-partisan tax policy which is intended to stimulate investment which would in turn lower the marginal rates of return and thus

the opportunity cost. Tr. 15502-10.

Certainly the most important of the three adjustments to the 4.78 percent weighted average is that associated with the concept of marginal rates of return. Dr. Goldfeld clearly stated the concept as follows:

> Q And you mentioned there were three categories of reduction to the 4.78 percent figure. You mentioned data revisions. What is next?
>
> A Well, the next one I think is really a quite important one, and one that deserves to be stressed, and it has to do with the distinction between the words "average" and "marginal." And I will explain those in a second, but let me just summarize the basic conclusion first.
>
> The Fraumeni-Jorgenson study basically gives us average rates of return. That is okay on its own terms as an estimate of average rates of returns. With the qualification of data revisions, I have little quarrel with the study. On the other hand, for purposes of making opportunity cost calculations and for defining a discount rate for making those opportunity cost calculations, the relevant thing is not the average rate of return, the relevant thing is the marginal rate of return, i.e., the rate of return which is earned on the last project, if you will, or the last bit of capital investment because when resources are diverted away from something, they are not diverted away from the average project, the best project is still going to get done, they are diverted away from the weak sister project, the one that just scrapes by.
>
> And it is very critical in this kind of thing to make the proper distinction between average and marginal. (Tr. 15505-15.)

* * *

THE WITNESS: Okay. As I said earlier, just a second ago, the difference between marginal and average is really a critical one for our purposes. The average refers to what one earns over all the capital one has, and the marginal, just by definition, refers to the last unit of capital. Now, and also as I have stressed, the marginal is the relevant concept for the opportunity cost. Furthermore, it is generally agreed that the marginal is less than the average. And there is a fancy phrase in economics for describing that, which has to do with diminishing marginal productivity of capital. All that means is if you add a lot of capital, you do less well than you did before. More simply put, it is a lot easier to understand if you think the way a businessman would think. They are going to rank projects by what their guesses are what they are going to pay off, what their rates of return are, and they are going to take projects, start at the beginning and take the highest rate of return project and march on down to the second one, and they get to the last one, which is sort of just basically barely profitable, and they will do that and quit. They won't take anything that's unprofitable, obviously, and these things go in a declining series, in some sense, and the marginal project, the last one done, is the one that has the lowest rate of return.

Now, coming back to the question you raised, which I think is a fair one, is that what one expects to happen in an economy like the United States' where there is a free capital market and where funds are allowed to flow from one industry to another industry, from one use to another use, one expects that smart people are going to find the best opportunities, and one expects, therefore, that if the marginal rate of return in one industry is a lot higher than the marginal rate of return in another industry, nobody is going to invest in the second industry until they have exhausted all the opportunities in the first industry, okay? Therefore, it is the profit motive or incentives of people who have the funds

and are doing the investing that, in effect, forces in each industry the marginal projects to have roughly the same rates of return, even though the average projects may not have the same rates of return. That's just a matter of luck, who gets in first, what's the nature of things. But in terms of the marginal projects, it is the nature of the capital system that funds flow to the most profitable opportunity, so even though the averages may vary, okay -- and I really disagree with the fact that even if the averages vary, it is a meaningful way to characterize that by taking that big range -- I think it is still much better to pay 4.78 as a summary statistic of those. Nevertheless, even though those averages vary, the marginals vary a lot less, so the discount rate which should be relevant for present purposes and, indeed, in any set of cost-benefit analyses of this sort, the discount rate that's relevant is the marginal one, and the marginal one is not to exhibit the kinds of variation the average ones do. It is going to be lower than the average one.

So one gets a clear sense that the range is misleading for another reason; really that it's a range of average rates of return, and we are not interested in that at all, we are interested in marginal rates of return, and those are less variable and they are smaller, so you get two messages out of that.
Tr. 15506-09.

Thus, after using the same approach used by both Dr. Brookshire and Mr. Dornbusch, that being the opportunity cost of capital for investment, and the same basic article used by Dr. Brookshire, Dr. Goldfeld's general conclusion supported Mr. Dornbusch's choice of a maximum of 4 percent. Tr. 15513. Dr. Goldfeld then went on to utilize two other accepted approaches

to show that the proper rate to apply may be lower than 4 percent.

Dr. Goldfeld felt that the opportunity cost of consumption was also an appropriate way to determine the discount rate, since two-thirds of the gross national product is in the form of consumption and might well be the source of the capital for the proposed projects. Tr. 15493, 15513-15517. By utilizing the rate of return from savings to determine the opportunity cost of capital displaced from consumption, Dr. Goldfeld testified that the relevant rate of return to use would be in the area of 1 percent, thus setting the lower bounds of the range that he testified to. Tr. 15516-15517. When asked to choose a single appropriate number to use within his range, Dr. Goldfeld testified that based on the evidence and his professional view, the only single sensible number would be 2 1/2 percent. Tr. 15518.

The third and separate approach that Dr. Goldfeld used was the Social Time Preference Theory. Tr. 15494, 15518-26. This approach accounts for the needs of future generations that are not accounted for in the discount rates discussed above. This has the effect of reducing the rate and reinforces the lower end of the range testified to by Dr. Goldfeld. Tr. 15523. Dr. Goldfeld pointed out that this is a time honored theory that is accepted in the profession. Tr. 15520. It must be noted, as Dr. Goldfeld did, that Dr. Brookshire has in the past been an advocate of this very theory using discount rates in his other writings of 0 to 2 1/2 percent. Tribes Exhibits DB-3, through DB-10, Tr. 14575-76. His explanations of why this situation was different

were unpersuasive. Dr. Goldfeld described this particular situation as being "tailor made" for the use of the Social Time Preference Theory, in view of the irreversible nature of the determination of water rights for the present and future needs of the Indians. Tr. 15523.

Thus, after viewing all of the testimony, it is clear that Dr. Brookshire's range of 4 to 11 percent is too high and that the appropriate rate is between 1 and 4 percent with the single best choice of a rate being 2 1/2 percent. Even assuming Wyoming's other challenges to Mr. Dornbusch's analysis are given some weight, an analysis using the 2 1/2 percent discount rate gives more than sufficient cushion to his analysis, thus making the proposed acreage economically feasible by any assessment. (See Economic Appendix immediately following this section of the brief).

Sensitivity Analysis

Mr. Jacobs conducted what he referred to as a sensitivity analysis which was to allegedly determine the effects of varying certain factors in Mr. Dornbusch's analysis. Wyoming Exhibit EJ-2. Mr. Jacobs reviewed Mr. Dornbusch's yields, prices, labor costs, and useful life of farm equipment. Wyoming Exhibit EJ-2, p. 1. The results of this analysis are misleading because it shows the cumulative effect of Mr. Jacobs unreasonable reductions to benefits and additions to costs. Tr. 14972. None of the changes by themselves are sufficient to bring the benefit cost ratios below 1.0. Mr. Jacobs quite carefully avoids showing this, although it can be determined mathematically. Tr. 14968-70.

The probability of several of Mr. Jacobs' unreasonable benefit reductions and cost additions combining one on top of another is highly unlikely.

Type VII and VIII

Mr. Dornbusch also conducted an economic feasibility analysis for the Type VII and VIII acreage presented by Mr. Stetson and Dr. Mesghinna. Tr. 5716-6276; United States Exhibit WRIR C-278. Mr. Dornbusch's Type VII analysis was very detailed, taking into account the particular characteristics of the historically irrigated land. He considered such things as sprinkler and flood irrigation, the inclusion of some Class 4 lands recognizing their lower quality, water short areas where a full supply is not always available, different crops where appropriate, parcel location and size as well as the necessity of soil amendments in certain limited situations. Tr. 5739, 5740-44, 5755-57. He developed benefit cost ratios for each Type VII parcel. Tr. 5721. The Type VIII analysis was generally the same as the future project analysis with the exception of the accounting for higher farm operation costs and lower field operation efficiencies due to the smaller field size. Tr. 5724. The lands were analyzed utilizing only hand-move sprinklers which is also due to field size. Tr. 5726. All appropriate cost adjustments were included.

Mr. Jacobs analyzed the Type VII and VIII lands as he did the future projects, including the same errors and overstatements of costs and understatements of benefits that he used for that analysis. Wyoming Exhibits EJ-3, EJ-4, EJ-14, EJ-15.

However, due to the smaller parcel sizes of these lands, the errors are magnified significantly on a per acre basis. Mr. Jacobs' overall analysis will not be covered in detail here to avoid repetition. Therefore, we incorporate by reference the criticisms previously voiced, including those relating to Dr. Brookshire.

Two examples of Mr. Jacobs' analysis are sufficient to show the results of his approach. Mr. Jacobs again used the 320 acre farm size and did not assume farmers would share the equipment even though the lands are in close proximity with some lands even sharing a common border. Tr. 14851-53. In his Type VII analysis he assumed even smaller acreages of crops such as beans which require special equipment, thereby allocating the costs of that specialized equipment over an even fewer number of acres resulting in even higher per acre farm operation costs than presented in the future project analysis. Tr. 14868-14876.

Unadjudicated In Use

Mr. Dornbusch was the only economist in the case to evaluate the claims presented by Mr. Billstein. Tr. 5767-68. His opinion that the proof of feasibility was in the pudding is a most reasonable approach. If the lands were not irrigable they would not be irrigated. Nothing more need be said regarding these lands.

Conclusion

Upon review of the testimony and exhibits regarding this subject matter, one can see that it is only the United

States' economic feasibility analysis that is reasonable. Mr. Dornbusch used reliable and reasonable methods, accepted economic principles and sound data. Mr. Dornbusch was supported on the important area of the discount rate by Dr. Goldfeld, an economist with impeccable credentials regarding the discount rate. Mr. Jacobs on the other hand used data that was designed solely to make the projects and claimed acreage fail economically.

There is not even reasonable agreement between the United States and Tribes on one hand and the State of Wyoming on the other as to the quantity of economically feasible irrigable acres on the Wind River Indian Reservation. In the five future projects the United States found 53,760 acres to be economically feasible while the State of Wyoming found 0 acres feasible (Tr. 14744-52). In the Type VII and VIII areas the United States found 9407 acres to be feasible while the State of Wyoming found only 2700 to 4000 acres of the Type VII land to be feasible depending upon the discount rate applied. Tr. 14837-38. The State of Wyoming found none of the Type VIII acreage in the Federal Irrigation Projects feasible to irrigate. Tr. 14753.

The State of Wyoming, through Mr. Jacobs, did not even try to make a fair and reasonable assessment of the economic feasibility of the acreage claimed by the United States. The incredible statistics just cited bear this out. As the Special Master exclaimed on page 14750-52 of the record, it is unbelievable that there was not one additional acre out of 280,000 acres on the Wind River Indian Reservation, including the currently

States' economic feasibility analysis that is reasonable. Mr. Dornbusch used reliable and reasonable methods, accepted economic principles and sound data. Mr. Dornbusch was supported on the important area of the discount rate by Dr. Goldfeld, an economist with impeccable credentials regarding the discount rate. Mr. Jacobs on the other hand used data that was designed solely to make the projects and claimed acreage fail economically.

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operating Federal Irrigation Projects, that could be farmed economically. To this Mr. Jacobs glibly responded - "that is the facts of life". Tr. 14751. The Wyoming analysis went too far and is thus not credible evidence. It must be disregarded.

ECONOMIC APPENDIX

FUTURE LANDS - FEASIBILITY ANALYSIS @ 2.5 PERCENT DISCOUNT RATE

If the feasibility analyses for the future lands were performed using a 2.5 percent discount rate instead of the 4.0 percent used in the analysis presented in Mr. Dornbusch's testimony, all five project areas would have shown considerably higher benefit cost ratios than Mr. Donrbusch presented in his testimony.

Gross returns for both highland and lowland areas would have remained the same as in the analysis using the 4.0 percent discount rate, but production costs would have been slightly lower. Production costs, suing the 2.5 percent discount rate would be $139.98 for malt barley, $143.77 for nurse malt barley, $75.02 for alfalfa, $168.89 for corn silage, and $146.14 for corn grain. Subtracting the production costs from gross returns yields net returns in the lowlands of $157.52 for malt barley, $121.21 for nurse malt barley, $171.66 for alfalfa, $149.11 for corn silage, and $89.58 for corn grain. Net returns in the highlands would be $130.42 for malt barley, $96.82 for nurse malt barley, and $150.46 for alfalfa. Using the same crop percent distribution as in Mr. Dornbusch's testimony, weighted average returns would be $156.01 in the lowlands and $138.47 in the highlands.

Using the same highland and lowland percentages for each of the five project areas as in Mr. Dornbusch's testimony, the

average annual net returns would be $152.76 for North Crowheart, $156.01 for South Crowheart, $154.50 for Bighorn Flats, $156.01 for Riverton East, and $156.01 for Arapahoe.

Subtracting the same annual on-farm irrigation operation and maintenance costs as presented in Mr. Dornbusch's testimony from the average annual net returns would show net benefits per acre of $147.76 for North Crowheart, $150.00 for South Crowheart, $149.30 for Bighorn Flats, $150.09 for Riverton East, and $150.60 for Arapahoe. Multiplying these annual net benefits by the appropriate 2.5 percent discount rate factor would show net present value benefits per acre of $5,478 for North Crowheart, $5,561 for South Crowheart, $5,535 for Bighorn Flats, $5,564 for Riverton East, and $5,583 for Arapahoe.

Using the same procedure as Mr. Dornbusch used to calculate the present values of the system development costs derived from Dr. Meaghinna's costs, but using a 2.5 percent discount rate, the present values of the system costs would be $3,307 for North Crowheart, $3,618 for South Crowheart, $4,525 for Bighorn Flats, $3,757 for Riverton East, and $2,946 for Arapahoe.

Dividing the present values of the net returns by the present values of the system costs derives the following benefit-cost ratios:

North Crowheart	- 1.78
South Crowheart	- 1.54
Big Horn Flats	- 1.22
Riverton East	- 1.48
Arapahoe	- 1.90

TYPE VIII LANDS - FEASIBILITY ANALYSIS @ 2.5 PERCENT DISCOUNT RATE

If the feasibility analysis for the Type VIII lands were performed using a 2.5 percent discount rate instead of the 4.0 percent used in the analysis presented in Mr. Dornbusch's testimony, all six project areas would have shown considerably higher benefit cost ratios than Mr. Dornbusch presented in his testimony.

Gross returns for both highland and lowland areas would have remained the same as in the analysis using the 4.0 percent discount rate, but production costs would have been slightly lower. Production costs, using the 2.5 percent discount rate would be $153.60 for malt barley, $156.26 for nurse malt barley, $88.98 for alfalfa, $181.23 for corn silage, and $155.87 for corn grain. Subtracting the production costs from gross returns yields net returns in the lowlands of $143.90 for malt barley, $108.72 for nurse malt barley, $157.70 for alfalfa, $136.77 for corn silage, and $79.85 for corn grain. Net returns in the highlands would be $116.80 for malt barley, $84.33 for nurse malt barley, and $136.50 for alfalfa.

Using the same crop percent distribution as in Mr. Dornbusch's testimony, weighted average returns would be $142.68 in the lowlands and $124.80 in the highlands.

The Upper Wind Unit is entirely above the highland-lowland elevation split, and therefore the average highland return of $124.80 applies. The other five units, (Coolidge, Johnstown, Subagency, Ray, and Arapahoe Ranch) are all below the highland-lowland elevation split, and therefore the average lowland return of $142.68 applies to them.

Multiplying these annual net benefits by the appropriate 2.5 percent discount rate factor would show net present value benefits per acre of $5,289 for the lowland units and $4,627 for the highland unit.

Using the same procedure as Mr. Dornbusch used to calculate the present values of the system development costs derived from Dr. Mesghinna's costs, but using a 2.5 percent discount rate, the present values of the system costs would be $3,046 for Coolidge, $2,794 for Johnstown, $2,867 for Upper Wind, $3,203 for Subagency, $3,518 for Ray, and $4,369 for Arapahoe Ranch.

Dividing the present values of the net returns by the present values of the system costs derives the following benefit-cost ratios of:

Coolidge	- 1.74
Johnstown	- 1.89
Upper Wind	- 1.61
Subagency	- 1.65
Ray	- 1.50
Arapahoe Ranch	- 1.21

XII DEPLETION AND NATURAL FLOW STUDIES

Mr. Toedter and Mr. Keene testified on behalf of the United States regarding the depletion analysis and the natural flow analysis. These formed the foundation for the water system operation and water availability analysis performed by Mr. Billstein.

None of the witnesses called by the State criticized Mr. Toedter's or Keene's results and indeed both Mr. Rice and

Mr. Fassett often cited their work in an attempt to buttress their testimony regarding the Fassett model.

Mr. Toedter's testimony is found in volumes 78 and 79 of the transcript and Mr. Keene's testimony in volumes 80 and 81. United States Exhibits WRIR C-287 through 293 were introduced in conjunction with Mr. Toedter's testimony and Exhibit WRIR C-293 is the result of Mr. Toedter's depletion analysis.

United States Exhibits WRIR C-296 through 302 were introduced in conjunction with Mr. Keene's testimony. Mr. Keene's work papers were introduced by the State of Wyoming as Wyoming Exhibits NK 2-4 and NK 300A and 300B.

XIII WATER AVAILABILITY

The United States, through Mr. Billstein, conducted a series of studies to determine whether or not there is a sufficient quantity of surface water available in the rivers and streams that service the agricultural, industrial, municipal and fishing claims presented by the various other federal witnesses. Tr. 7214-7412, 7543, United States Exhibit WRIR C-305. A priority date of 1868 was used by Mr. Billstein for all claims presented by the United States. Tr. 7287, 7290.

Mr. Billstein's study assessed the various water demands against the water supply information presented by Mr. Keene, the hydrologist for the United States. Appropriate hydrologic base periods were utilized in the respective studies. United States Exhibit WRIR C-301, Tr. 7233-34, 7258, 7270, 7302, 7308, 7310, 7313, 7319-20, 7325, 7355, 7363. The studies also accounted for

agricultural return flows. This information was compiled jointly between Mr. Billstein and Mr. Toedter to account for quantity, locations and monthly distribution. Tr. 7243-53, 7407-08, United States Exhibit WRIR C-294.

Mr. Billstein's analysis was conducted using a computer program which is generally accepted in the profession for such studies. Tr. 7255-56. This computer program allows for reservoir operation, accounts for inflows, demands, depletions, and return flow while continuously monitoring the remaining riverflow month by month in the downstream direction at various control points. Tr. 7256, 7436, 7257-58, 7262-70, 7296, United States Exhibits WRIR C-307, WRIR C-308 and WRIR C-316.

The overall results of Mr. Billstein's studies shows that in all but the very dry years of the hydrologically representative base periods used, there is a sufficient quantity of surface water to meet the various water claims of the United States. In the instreams where there are shortages in the dry years, Mr. Billstein, after a considerable amount of research on the topic, determined that the solution was to increase the irrigation efficiencies and or management of available soil moisture or other crop related management. This increase of efficiencies can only be accomplished on a short term basis.

Mr. Billstein's conducted an evaluation of the municipal and industrial water requirement of the United States' claim. He determined that there was sufficient water available to serve those claims. Tr. 3389, 7392-93.

An evaluation was also conducted to determine whether there was sufficient water available to meet the optimum fishery flows claimed by the United States. Tr. 7393. Mr. Billstein determined that in most instances there was sufficient water available in addition to the United States' agricultural, municipal and industrial claims, to meet the flow requirements. In those instances where there were conflicts between the various United States claims, Mr. Billstein identified and categorized the conflicts as potential, minor or major. Tr. 7397-98, United States Exhibits WRIR C-309 through WRIR C-315.

In those instances where there is not sufficient water in the dryer years to meet all of the United States' agricultural, municipal, industrial and fishery claims, the choice of which claims to be served or uses to be met will rest with the Tribes. This is a reasonable and realistic way to handle this situation if and when the Tribes reach the point of full utilization of their water rights.

The result of water availability for the United States' claims went unchallenged by the State of Wyoming. The only related testimony and evidence presented by the State relating to water supply was the now famous "Fassett model" which was designed to attempt to determine the joint adverse effect of the United States and tribal water claims or persons holding State water rights in the Big Horn basin. It was thus not designed to rebut or challenge the results of Mr. Keene's natural flow analysis or Mr. Billstein's system operations study. Tr. 9504.

XIV

AESTHETICS AND WILDLIFE

The United States' claim to water for maintenance of wildlife and aesthetic values on the Wind River Reservation are coextensive. The claims are for one hundred percent of the natural flows occurring in streams and creeks lying within the geographical areas of the reservation depicted on United States Exhibit WRIR C-7. Those areas are in the higher elevations of the reservation and consist almost entirely of trust land. Mr. Harbour for the United States and Mr. Martin for Wyoming concurred in the designation of the northern, or Owl Creek Range, lands as wildlife habitat. As to the southwestern, or Wind River Range lands, Mr. Martin concluded that some of the lands in the lower elevation contained degraded habitat that could be improved. However, he did not testify that the lower elevation boundary should be located elsewhere than as designated by Mr. Harbour. Regarding the aesthetic value of the same areas, Mr. Keith for Wyoming concluded that 70 to 80 percent of the lands related by Mr. Harbour would be classified as A on B lands under the Visual Resource Management System of the Bureau of Land Management. Thus, there is no significant difference in the geography of the claims in the testimony of the witnesses for the United States and Wyoming.

Mr. Martin concluded that 30 percent of average annual flows is sufficient for maintenance of wildlife values, while Mr. Keith concluded that 60 percent flow would maintain the aesthetic quality of the streams in the claimed area.

No party contends that instream flows less than 30 percent of the average annual flows would be sufficient to maintain aesthetic and wildlife habitat. The government's claim for 100 percent of the flows is non-consumptive and has not been shown to interfere with existing or proposed water uses upstream or downstream of the claimed area. For these reasons the United States claims is adopted as the measure of the right for aesthetic and wildlife needs.

XV

LIVESTOCK

Dr. Carver for Wyoming and Mr. Merchant for the United States do not differ greatly in their conclusion as to the current size of the cattle industry on the reservation. Mr. Merchant uses 25,000 head as the estimate for the current (average over the past several years) level, while Dr. Carver concludes that a

herd of 22,288 head is appropriate. Wyoming Exhibit LC-5, United States Exhibit WRIR C-17. Mr. Merchant's figure is based on discussion with Mr. Bob Robertson, Range Operations Officer, and Dr. Carver's figure is based on 8 year average of BIA statistics. Tr. 283, Wyoming Exhibit WRIR LC-5.

Dr. Carver concludes that it is feasible to expand the cattle industry by 25 percent, to 28,900 head, while Mr. Merchant concludes that a 50 percent expansion is feasible, to 37,500

head. United States Exhibit WRIR C-17, Wyoming Exhibit WRIR LC-4. The basic disagreement between the two is the extent to which the summer rangeland is presently underused. Mr. Merchant's estimate is again based on discussions with the Range Operations Officer, while the basis of Dr. Carver's opinion on potential expansion is unclear. Tr. 282-283, 11905, 1153.

Both Mr. Merchant and Dr. Carver conclude that a financial analysis would show expansion to be feasible. Tr. 373, 11953. Mr. Merchant concludes that an economic analysis also shows feasibility. Tr. 373.

Dr. Carver concludes that if an economic analysis were made, an expanded livestock industry would prove to be infeasible. Tr. 11943. Nevertheless, he believes that expansion will occur because there is a strong devotion to ranching life. Tr. 11952-53. Dr. Carver's economic analysis was unnecessarily conservative. He relied on a discount rate of 7 1/8 percent that witnesses for both Wyoming and the United States testified was substantially lower. Tr. 11950, 12083-12084. Dr. Carver also assumed that current tribal policies limiting herd sizes and use of cross-breeds which adversely affect ranching economics would remain in effect. Tr. 12070-71. Dr. Carver assumed that no calves would be kept over the winter to be sold as yearlings. Tr. 12073. Dr. Carver failed to recognize that the opportunity cost of using otherwise unemployed labor and otherwise unproductive land is zero. Tr. 11942, 11987-88; 11990-93. Finally, Dr. Carver used cattle prices from years when they were lower than would be

representative of longer term prices. Tr. 12104-05.

Water requirements for the livestock are a combination of the consumption by the livestock and evaporation and other losses that occur in providing water to the animals. Dr. Carver's and Mr. Merchant's conclusions about consumption are comparable. Dr. Carver's opinion is that 12 gallons per day are needed for each head of cattle and horses and six gallons per day are needed for each game animal. Tr. 11957-59.

Mr. Merchant concluded that the daily requirements for water are 15 gallons per head. Tr. 387. The current animal water requirements for livestock were calculated by Mr. Merchant to be 420 acre feet. Dr. Carver concludes that 307 acre feet annually are currently required for direct consumption. The reservation livestock industry could be expanded in Mr. Merchant's opinion to 37,500 head with an annual consumption requirement of 630 acre feet. Dr. Carver believes the herd can be expanded only to 28,900 cattle, 4,000 horses and 6,000 game animals which will consume 485 acre feet annually.

The second component of livestock water needs is evaporation and other losses. Mr. Merchant and Dr. Carver differ substantially in this respect, primarily because of a difference in the average stockpond size used in calculations by each party. Mr. Merchant based his figure of 2 acres per stockpond on information from the reservation's Range Operations Officer, while Dr. Carver based its figure of .75 acre per stockpond on an assumed average annual value. Tr. 389, 11961. Two other elements in the analysis of evaporation reveal similar differences between

Mr. Merchant's and Dr. Carver's conclusions. Mr. Merchant used a figure of 280 existing stockponds, based on a current estimate from the Range Operations Officer, while Wyoming used 270 stockponds based on a 1973 Phase I study. Tr. 389, 11961. The other remaining difference is in evaporation rates. Mr. Merchant used an annual rate of 2.5 acre feet per acre, based on matching evaporation data for various areas on the reservation with the location of stockponds. Tr. 389-90. Dr. Carver used 2.15 acre feet per acre, based only on evaporation data from the Upper Wind Reservoir, Tr. 11960-61, while Dr. Carver later admits that evaporation is higher in the lower elevations. Tr. 11967. Wyoming also admitted that no seepage losses were included in their estimate of livestock water use and no determination was made of the proportion of seepage losses that were lost to deep percolation. Tr. 11968. Given these above factors, the respective conclusions of Mr. Merchant and Dr. Carver as to total evaporation losses are:

	Current	Future	
Mr. Merchant	1400 AFY	2100 AFY	U.S. Ex. WRIR C-17
Dr. Carver	443 AFY	515 AFY	Wyo. Ex. WRIR LC-4

The total water requirements resulting from direct consumption by livestock and for evaporation for the claims as presented by the United States and reviewed by Wyoming are:

	Current	Future	
United States	1820 AFY	2730 AFY	U.S. Ex. WRIR C-17
Wyoming	750 AFY	1000 AFY	Wyo. Ex. WRIR LC-4

Neither Mr. Merchant nor Dr. Carver distinguished between surface and groundwater as the source of livestock water. Mr. Merchant did provide an estimate of the breakdown by watershed. United States Exhibit WRIR C-17, Tr. 395:

	Current	Future
Wind River	580 AFY	870 AFY
Little Wind River	580	870
Popo Agie	40	60
Owl and Red Canyon Creek	620	930
Total	1820	2730

The court should conclude that, while there are differences between Dr. Carver's and Mr. Merchant's analyses, Mr. Merchant's analysis is reasonable and justifies the entitlement to annual consumptive use of 2,730 acre feet.

XVI

GROUNDWATER

The United States' witness, Oliver Page, identified the geological formations bearing groundwater on the reservation. Groundwater sources included the alluvial deposits in streambeds and late Tertiary and older formations. The potential yields from those formations were concluded by Mr. Page to be adequate to supply the water needs for developing the mineral resources on the reservation that had been identified by James P. Merchant. United States Exhibit WRIR C-31A (Table 4). Mr. Page also located groundwater and subsurface underflow water sources for municipal water requirements identified by Mr. Merchant. United States Exhibit WRIR C-18, Tr. 404, 483-486.

The State of Wyoming made no attempt to impeach the evidence presented by the United States regarding sources and availability of groundwater. Tr. 11870.

XVII MINERALS

The witness on behalf of the United States, Mr. Merchant, reviewed the characteristics of the mineral deposits on the reservation, analyzed trends in the grade of ore being ploited elsewhere, and conducted market evaluations by examining trends in building new plant capacity for using the minerals. The market studies implicitly considered the costs and returns of exploiting minerals by analyzing trends in the grade of ore being developed. The lower the grade of ore the higher the cost per ton of mineral produced, and therefore the higher the price must be to allow profitable development.

In contrast, the witness from Wyoming, Mr. Watts, conducted no in depth study of the feasibility of developing any reservation minerals. Instead of conducting an independent review of reservation mineral prospects, Mr. Watts simply sought to reduce the claim offered by the United States. In this context it should be noted that Wyoming did not consider the minerals that Mr. Merchant testified were present on the reservation but that Mr. Merchant considered infeasible of development: iron, bentonite and zeolite. Neither did Mr. Watts' attempt to assess the water requirements for secondary oil recovery at Northwest Sheldon Dome.

In addition to testifying that he did not do any in depth analysis of the minerals, Mr. Watts:

-did no review of future water requirements;

-did no review of ancillary water uses;

-admitted to finding water use in secondary oil recovery confusing;

-admitted he did not include water for steam injection;

-admitted he did not understand in-situ coal gasification;

Mr. Watts' conclusions were partially based on the possibility of future substitutions for certain minerals. Mr. Watts gave the examples of substituting coal for wood in England and of finding substitutes for phosphates in laundry detergents. His Victorian England example of substituting coal for wood is hardly relevant, or at least he fails to demonstrate any relevance,

and his detergent example overlooks the fact that while the use of phosphate for detergents is declining the other uses of phosphates are increasing even faster so that the overall use of phosphates is increasing. Tr. 619-20.

OIL

Mr. Merchant and Mr. Watts both base their conclusions on secondary oil recovery at Winkelman Dome, Lander and Steamboat Butte oil fields. Mr. Merchant's conclusion is 6580 acre feet annually (AFY) of which 1030 AFY is taken from the Wind River and the remainder is from groundwater. Mr. Watts' totals were somewhat unclear. Mr. Watts also admits that his figures do not include any water for steam injection at those fields. Both Mr. Merchant and Mr. Watts agree that trying to project any new water use in secondary oil recovery would be speculative.

GAS

Mr. Merchant and Mr. Watts agree that the natural gas sweetening plant on the reservation currently requires about 6 AFY from wells. Both parties also agree that the sulfuric acid plant on the reservation currently requires about 95 AFY from wells. Mr. Watts disputes that the acid plant should be included in the claim because it does not currently use sulfur from reservation sweetening plants as its raw material and because it uses natural gas only 4 - 7 days per year to start the combustion process. However, the plant does use natural gas for part of the

year, presumably from reservation wells. Mr. Watts admitted that he does not know that sulfur from reservation natural gas could not be used in the acid plant; the acid plant exists and operates on the reservation, using water from the reservation.

The United States claims water for a proposed anhydrous ammonia plant that would use either reservation natural gas or gas from the in situ gasification plant, or both. Mr. Merchant determined that between these two gas sources the gas supply is adequate. Mr. Merchant conducted a market study to examine long-term trends in the use of nitrogen fertilizers in the west north central states and found that a plant would consume about 4250 AFY from either the Wind River or groundwater. Mr. Watts concluded that such a plant was speculative because there was no assurance that gas production would remain at today's level. Mr. Watts also admitted that he had not gathered enough information to say whether an ammonia plant would ever be built on the reservation.

COAL

The witnesses agree that there is no current coal mining on the reservation but that there are two coal deposits with development prospects: Muddy Creek and Alkali Butte. The Mr. Merchant analyzed these deposits and concluded that development of a mine and a 150 MW mine-mouth power plant at the Muddy Creek site could be feasible, requiring 25 AFY for dust control and surface reclamation and 2490 AFY from the Wind River for power plant cooling. Mr. Watts claimed that his calculations showed

that such a plant would have a life of 13-14 years, too short to be feasible but there is no evidence that the Mr. Merchant considered a plant life so short. The dispute, therefore, may be one over the size of the recoverable reserves and is impossible to resolve because neither Mr. Merchant nor Mr. Watts documented their reserve findings. Mr. Watts, explicitly, and Mr. Merchant, implicitly, in their conclusions as to the feasible use of Muddy Creek coal concluded that mining coal simply to export to an off-reservation power plant would be infeasible.

Alkali Butte has coal deposits apparently suitable for in situ gasification. Mr. Merchant concluded that gasification would required 2800 AFY from groundwater. Mr. Watts first admitted not understanding the subject, then pointed out that development would encounter boundary problems and would have to be undertaken jointly between the Tribes and its neighbors. Mr. Watts also stated that water would not be needed to control the temperature of the burn because of the moisture content of the coal, but he admitted not knowing about the other uses for water regarding in situ gasification, did not comment about water requirements for above ground facility cooling and for steam injection as a source for hydrogen, and did not offer an alternative water requirement.

PHOSPHATE

The witnesses agree that there is no current development of the reservation's phosphate deposits but there are deposits on the reservation. Mr. Merchant found that there is an increasing demand for phosphate, even considering the declining use of phosphates for detergents. He found that there has been a trend to lower grade phosphate ores and that beneficiating the grade ore that exists on the reservation has only recently become feasible, and that it is likely that the reservation's deposits would become feasible to exploit in the future. Development of the deposits would require 5 AFY from wells near the deposits for dust control, 425 AFY for beneficiating the ore and 400 AFY for an acid plant to produce phosphoric acid fertilizer. The beneficiating plant and acid plant would be located near Riverton and would draw water either from the Wind River or from groundwater. Mr. Watts disputes the feasiblity for two reasons: underground mining would be reuqired and substitues may be found for phosphates. The criticism of underground mining looks only to today's practices and ignores the extent to which new practices are employed over time and will be necessary in the future. Mr. Watts' assertion that the discovery of

substitutes for phosphates in laundry detergents will diminish the need for phosphate mining in the future overlooks the evidence that in spite of the decreasing use of phosphates in detergents that overall use of phosphates is increasing.

GYPSUM

No gypsum is currently being produced on the reservation but it is uncontroverted that the reservation contains massive deposits of high-grade gypsum. Mr. Merchant concluded that development of these gypsum deposits by surface mining and wallboard manufacturing plants would be feasible. The surface mine would require about 10 AFY from wells for use in surface reclamation. The wallboard plant would need 300 AFY, whic would come either from groundwater or from the Wind River. At the production rate postulated the gypsum deposits would last hundred of years.

Mr. Watts failed to recognize that the proposed gypsum mine would be a surface mine, and this failure appears to have been the basis for his opinion that gypsum mining was infeasible. Because of this misunderstanding Mr. Watts' opinion should be given little weight. Tr. 11559, 11563.

URANIUM

Mr. Merchant testified to the presence of uranium deposits on the reservation although there has so far not

been any ground exploration and identification of the deposits. Indications are that uranium ore would be about 0.1 percent uranium and that mining would be underground. 15 AFY would be needed for dust control and incidental uses associated with mining. About 475 AFY would be required for a yellowcake plant. All water would come from Crow Creek.

Mr. Merchant's testimony is summarized in United States Exhibit WRIR C-29. Mr. Watts' testimony as to water requirements for reservation mineral development is as follows:

Oil Secondary Recovery

Steamboat Butte - wells	94AFY
Steamboat Butte - produced water	940AFY
Winkelman Dome & Lander - wells	3900AFY

Natural Gas

Sweetening Plant	6AFY

Mr. Merchant's testimony regarding mineral development is thorough and based on reasonable projections of mineral use. Mr. Watts did no independent evaluation of the mineral development potential on the reservation or the attendant water requirements. Based on the evidence adduced at trial it is clear that Mr. Watts' attempt to impeach Mr. Merchant's testimony was unavailing.

MINERAL INDUSTRY CHARACTERISTICS AND WATER REQUIREMENTS
WIND RIVER RESERVATION, WYOMING

Mineral	Activity	Location	Output Associated With Peak Water Use	Peak Annual Water Use (AF/Year)
Oil	Enhanced Recovery	Multiple Locations	4.12 mm B/Y petroleum	6,580
Natural Gas	Refining	1S-6E (East of Riverton)	8.5mm scfd natural gas	6
	Sulfuric Acid Production	1S-4E (Riverton Area)	180 T/day sulfuric acid	95
	Anhydrous Ammonia Production	1N-4E (Riverton Area)	1,000T/day ammonia	4,250
Coal	Surface and Underground Mining	6N-1E (Muddy Creek Area)	1,400 T/day coal	25
	In Situ Gasification and Syngas Production	2S-6E (Alkali Butte Area)	55 mm scfd high BTU gas	2,800
	Electricity Generating Station	6N-1E (Muddy Creek Area)	150 MW electricity	2,490
Uranium	Underground Mining	7N-5W	750 T/day ore	15
	Yellowcake Processing	7N-5W	300 T/year yellowcake	475
Phosphate Rock	Underground Mining	1S-2W	1,600 T/day ore	5
	Beneficiation & Calcining Plant	1N-4E (Riverton Area)	700 T/day beneficiated ore	425
	Phosphoric Acid Production	1N-4E (Riverton Area)	200 T/day 100% P_2O_5	400
Gypsum	Surface Mining	7N-1E/3W	820 T/day gypsum	10
	Wallboard Production	1N-4E (Riverton Area)	410 million sq. ft. per yr. wallboard	

XVIII

MUNICIPAL

The United States' claim for municipal water supplies was based on the present and future populations of Indians on the reservation. The State of Wyoming conceded that the population projections of the United States' witness, James Merchant, are accurate and did not present any evidence to contradict those projections. Tr. 11606, 11620.

Mr. Fassett testified for Wyoming that he concurred in all the per capita water consumption calculations of Mr. Merchant except those for Fort Washakie. Since Mr. Merchant's figures were based on actual use and Mr. Fassett's figures were estimated, the Court ought to adopt Mr. Merchant's conclusions.

Mr. Fassett did not dispute Mr. Merchant's estimate of Indian population in Riverton but argued that Indians residing in Riverton could rely on that city's municipal water system. Nonetheless a measure of the reserved right should include water for the Riverton Indian population because the water requirement is tied to that population and not its location.

XIX

FISHERY

Instream flow requirements for fishery maintenance are being calculated with evolving systems employing field data and computer analyses. The United States chose the

incremental methodology of the Fish and Wildlife Service's Cooperation Instream Flow Group (IFG) for calculating instream flows. Other methods considered but rejected in favor of the IFG were the Tennant Method, the Habitat Quality Index, and the Water Surface Profile. Tr. 6343-45, 6574-76. Mr. Vogel testified that results obtained from the IFG incremental methodology are more useful and more meaningful than the other methods he considered. Nothing in the evidence submitted by the witness for Wyoming, James Sinning, contradicts Mr. Vogel's conclusion. Indeed he testified that based on an evaluation of the IFG incremental methodology in which he participated, the IFG concluded that the methodology was useful and officially adopted it. Tr. 15243-45.

Mr. Vogel's work in applying the incremental methodology to the streams he selected on the reservation is thoroughly documented and carefully executed. The evidence clearly shows that he conducted extensive field and office analyses in reaching his conclusions. United States Exhibit WRIR C-280, pp. 9-18, Tr. 6360-6553. In contrast, Mr. Sinning did no field work at all other than simply visit three of Mr. Vogel's study sites and fly over the streams by helicopter. Tr. 15277-78.

In his direct examination Mr. Sinning testified that Mr. Vogel had made numerous errors in his computer and field analyses. His testimony however never amounted to more than conclusory statements unsupported by anything other than argumentative testimony. Tr. 15264.

Mr. Vogel's testimony is credible, well-founded and uncontroverted. The United States' instream flow claim should be adopted by the Court.

XX

BURDEN OF PROOF

Under Wyoming law, the United States sustains its burden of coming forward with evidence when it demonstrates that 1) the waters which it claims a right to divert arise, flow through, or border upon the Wind River Indian Reservation as established in 1868; 2) the lands that are to be irrigated lie within the reservation boundary and/or are owned by the United States, and 3) that said lands are susceptible of irrigation.[28/] Thus, in Merrill v. Bishop, 69 Wyo. 45 (1959), the Supreme Court of Wyoming would not sustain a demurrer filed by the State engineer to a complaint alleged the facts set out above, ruling that the allegations made out a prima facie senior water right. Id. at 60.

Under Wyoming law, once the United States has made out a prima facie case for a senior water right, the State of Wyoming cannot shift the burden of proof by merely denying the existence of the United States senior water right. Merrill v. Bishop, supra at 61. The State has the burden of rebutting the prima facie case of the United States by demonstrating (1) that the waters which the United States claims a right to divert do not arise, flow through, or border upon the reservation as established in 1868; (2) that the lands which the United States claims are susceptible to irrigation do not lie within the boundaries of the reservation as established in 1868 or are not held in trust by the United States; (3) or that the lands are not susceptible of irrigation.

Through the testimony of Mr. Kersich and Mr. Waples, the United States has identified lands inside and outside of the stipulated reservation boundaries that are arable. All of the lands so identified are held in trust by the United States for the benefit of the Shoshone or Arapahoe Tribes or individual members thereof. Through the testimony of Dr. Mesghinna, Mr. Stetson, Mr. Billstein and Mr. Dornbusch, the United States has identified those lands that are practicably irrigable. Through the testimony of Mr. Billstein, the United States has identified waters arising in, flowing through, or bordering on the Wind River Indian Reservation and trust lands in sufficient quantities to satisfy the diversion and irrigation requirements of those arable lands capable of sustained irrigation. The United States has therefore made at least a prima facie case that it is entitled to divert the amount of water required to irrigate said lands and that the priority date of this right to divert is

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28/ The United States does of course claim water rights for lands outside the reservation boundaries that have been acquired in trust for the Tribes. The United States does not claim an 1868 priority date for these lands. The United States believes that under Merrill v. Bishop it sustains its burden of coming forward when it shows that the land is held in trust, is arable, and can be served from adjacent waters.

July 3, 1868, the effective date of the treaty between the United States and the Tribes, or for that area north of the stipulated boundary, the date of purchase or the date of the State water right, whichever is the earliest date.

Neither the State nor any of the parties adverse to the United States has come forth with any evidence that contradicts or challenges the conclusions of Mr. Kersich and Mr. Waples with respect to the arable lands within the reservation boundaries. At best, and taken in the light most favorable to the State and private parties, the testimony of the State's experts, Mr. Sommers and Mr. Fowkes, is that they could not determine whether all of the lands identified by Mr. Kersich and Mr. Waples are arable. In sum, the statements made by Mr. Sommers and Mr. Fowkes to this Court were to the effect that they could not rebut the findings and conclusions of Mr. Kersich and Mr. Waples. Since, as a matter of State law, the parties opposing the claims of the United States have the burden of persuasion, if they wish to rebut the prima facie case of the United States, this Court must conclude that the findings and conclusions of Mr. Waples and Mr. Kersich stand unimpeached and that the lands they have identified as arable are in fact arable.

This Court must conclude that the testimony of the State's experts, Mr. Sommers and Mr. Sostrom, regarding the

unadjudicated lands that are under current irrigation, fails to rebut the evidence offered by the United States through the testimony of Mr. Billstein. Mr. Sommers and Mr. Sostrom, in all of their various "studies", failed to credibly show that the lands, identified by Mr. Billstein through on-site inspection as currently under irrigation, were not irrigated.

This Court must likewise conclude that the testimony of the State's experts, Mr. Bishop and Mr. Sostrom, regarding the design and costs of irrigation facilities to serve the arable lands identified by Mr. Kersich and Mr. Waples, failed to meet or rebut the evidence offered by the United States through Dr. Mesghinna and Mr. Stetson.

Mr. Bishop and Mr. Sostrom, the State's witnesses, often adopted wholesale the work, methodology and conclusions of Dr. Mesghinna or Mr. Stetson. In areas where they disagreed with the conclusions of the United States experts, Mr. Bishop and Mr. Sostrom gave as their rationale that they did not have sufficient information from Dr. Mesghinna or Mr. Stetson to arrive at a conclusion as to the reliability of their conclusions. As a matter of law such testimony is legally insufficient to meet the State's burden to rebut the United States' prima facie case. The court would note that Mr. Bishop and Mr. Sostrom accepted Dr. Mesghinna's and Mr. Stetson's

conclusions when they felt that they did have enough information, that the State of Wyoming did not challenge the expertise of Dr. Mesghinna or Mr. Stetson and that, at the request of counsel for the State of Wyoming, a Mr. James Cannon of the engineering firm of Bookman-Edmonston reviewed the testimony and exhibits of Dr. Mesghinna and Mr. Stetson and found all of their conclusions to be acceptable.

With respect to the issues of water duties for the "historic" lands, Mr. Bishop expressed disagreement with Mr. Stetson. However, it is clear from the testimony that Mr. Bishop's conclusions on water duties were prepared by Mr. Sostrom, who is not qualified and was found by this Court not to be qualified - to state legally admissable opinions with respect to water duties. The testimony offered by the State with respect to water duties is legally deficient and also not credible.

The State of Wyoming did not seek to rebut the testimony of Mr. Billstein with regard to the availability of water from the streams that arise in, flow through, or border on the 1868 reservation to meet the diversion requirements or water duties testified to by Dr. Mesghinna and Mr. Stetson. Mr. Fassett who testified on behalf of the State of Wyoming disclaimed any intent of criticizing Mr. Billstein's

work or conclusions. Mr. Fassett's testimony was that there is insufficient water to meet the claims of the United States, additional claims independently made by the Tribes, and the demands for water by non-Indians whose state rights were assumed to be valid by Mr. Fassett and Mr. Christopolous, the State engineer. Even if Mr. Fassett's conclusions were absolutely correct and legally relevant, they were not intended to, nor did they, rebut the conclusions of Mr. Billstein.

Under the law of the State of Wyoming, therefore, the testimony of Mr. Billstein that there are sufficient waters on the reservation to meet the water requirements claimed by the United States stand unimpeached and must be adopted by this Court.

Section 194 of Title 25 of the United States Code provides that in trials between Indians and "white persons" involving property rights, the burden of proof is on the white person whenever the Indian makes out a presumption of title from the fact of previous possession or ownership. The term "Indian" includes the United States acting on behalf of a tribe and "white person" includes all non-Indians entities other than states. Wilson v. Omaha Tribe, 442 U.S. 653 (1979). In our view the United States makes out a prima facie case according to Wyoming law when the United States makes out

the presumption of previous ownership when it demonstrates that the waters arise, flow through, or border upon the 1868 reservation, that the lands are trust lands, and that the lands are susceptible to irrigation. Thus, the burden of proof under 25 U.S.C. 194, does not differ in any way then the burden under applicable Wyoming law. The fact that the term "white person" as used in 25 U.S.C. 194, does not include a state is therefore an irrelevancy since the State has the burden of rebutting the prima facie case under state law. However, we would note that the provisions of 25 U.S.C. 194, do apply to all non-Indian parties to this lawsuit, other than the State of Wyoming, and does apply to the State insofar as it is acting as the attorney or representative of the non-Indian users rather than a proprietor or claimant of a right to divert water. If the State is merely acting as the representative of the non-Indians, the non-Indians are the real parties in interest and are subject to 25 U.S.C. 194.

XXI CONCLUSION

The basic elements of the reserved rights doctrine have been clearly established. At the date the Wind River Indian Reservation was established, sufficient water was impliedly reserved from appurtenant surface and undergound sources to fulfill the purposes of the reservation. See Winters v. United States, supra; Cappaert v. United States,

supra. The reserved right although unquantified or unused is a perfected, vested property right. Federal rights are controlled by federal law and are not dependent upon state law or procedure for their existence, nature and extent, whether or not an adjudication action is in state court. Dugan v. Rank, 373 U.S. 609 (1963); Cappaert v. United States, supra at 143.

Respectfully submitted this 7th day of April, 1982.

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IN THE DISTRICT COURT OF THE

FIFTH JUDICIAL DISTRICT

STATE OF WYOMING

IN RE: THE GENERAL ADJUDICATION OF ALL RIGHT TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING	)	Civil No. 4993

INTERLOCUTORY DECREE OF WATER RIGHTS FOR THE WIND RIVER INDIAN RESERVATION

ARTICLE I

Definitions

For purpose of this decree:

(A) "Diversion requirement" means the amount of water necessary to be diverted from naturally occurring streams or from groundwater sources to supply the concumptive beneficial uses for the Indian water rights.

(B) "Indian water rights" means water rights reserved by the Treaty of Fort Bridger, July 3, 1868, and held in trust by the United States of America, for the benefit of the Shoshone and Arapahoe Indian Tribes of the Wind River Indian Reservation, as quantified, described, and set forth in Article II, Sections 1-6, and Article III, Sections 1 and 2 of his decree.

(C) "Beneficial use" means the use of water for any purpose from which benefits are derived. Such use includes but is not limited to: municipal purposes, domestic purposes, irrigation, development of hydroelectric power, industrial and mineral development, instream flows for preservation of fishery habitat, preservation of aesthetic and wildlife areas, livestock consumption and stock pond evaporation.

(D) "Fishery flow" means the optimum mean monthly flow which will produce maximum fish habitat in a given stream reach.

(E) "Aesthetics and wildlife flow" means 100 percent of the naturally occurring water in the lakes and streams in the areas depicted on United States Exhibit WRIR C-6, which is hereby incorporated by reference and made a part of this decree.

(F) "Natural flow" means all water in the rivers, streams, seeps, springs and naturally occurring lakes which is unimpaired by man-made diversions and affected only by natural influences.

(G) "Livestock water requirements" means the diversion requirement necessary to satisfy the needs of livestock or evaporated from stockponds maintained for livestock watering purposes on the Wind River Indian Reservation.

(H) "Agricultural water requirements" means the diversion requirement to supply the net irrigation requirements of the crops and associated distribution, conveyance, and on-farm losses.

(I) "Mineral and Industrial water requirements" means the diversion requirement necessary to satisfy the needs of the various industries listed in Article II, Section 4 below.

(J) "Municipal water requirements" means the diversion requirement necessary to satisfy the personal water needs for the Indian population of Ft. Washakie, Riverton, Ethete, Boulder Flat, Arapahoe, Pavillion and remaining rural areas of the Wind River Indian Reservation for domestic, commercial and light industrial use.

(K) "Mean monthly flow (MMF)" means the average flow, expressed in cubic feet per second, continuously available throughout a given month.

(L) "Stream reach" means that section of river or stream designated in United States Exhibit WRIR C-281 which is hereby incorporated by reference and made a part of this decree and described in Article II, Section 6 below which depicts the section of river or stream throughout which fishery flows are required.

(M) "Diversion" means (1) the act of taking of water from a stream or other body of water into a canal, pipe, or other conduit; (2) a man-made structure for taking water from a stream or other body of water.

(N) "Non-Consumptive use" means the use of water in a way that does not reduce a supply. Examples include hunting, fishing, boating, and swimming, instream flows and preservation of natural lake levels.

(O) The boundaries of the Wind River Indian Reservation have been stipulated to by the parties. That stipulation is attached hereto as Appendix 1.

ARTICLE II

IT IS ORDERED, ADJUDGED, AND DECREED that the United States has reserved, by virtue of the Treaty of Fort Bridger, July 3, 1868, and for the benefit of the Shoshone and Arapahoe Tribes of the Wind River Reservation, the right to divert water, or to have water diverted, in the amounts set forth herein, and from the streams set forth herein, and further that said right has a priority date of July 3, 1863, and the United States or the Shoshone and Arapahoe Tribes shall have the right to prevent the diversion of water from said streams by persons whose priority date does not predate July 3, 1868, if said diversion would interfere or prevent the United States or the Shoshone and Arapahoe Tribes from fully enjoying and utilizing the rights herein granted and recognized.

Section 1

AGRICULTURAL WATER REQUIREMENTS

PRIORITY DATE: July 3, 1868

Description	Water Right Acreage (acres)	Average Annual Diversion (AF/acre)	Annual Diversion Requirement (acre-feet)	Source of Water Supply (description)
1. PROJECT LANDS				
A. Project Lands - Future				
1. North Crowheart Unit	38,773	3.81	147,767	Wind River
2. South Crowheart Unit	4,695	4.29	20,137	Wind River
3. Arapahoe Unit	3,808	4.39	16,720	N.F. Popo Agie River
4. Bighorn Flats Unit	1,702	2.79	4,748	Wind River
5. Bighorn Flats Unit	968	2.55	2,464	Little Wind River
6. Riverton East Unit	157	3.16	496	Little Wind River
7. Riverton East Unit	272	3.16	861	Big Horn River
8. Riverton East Unit	3,385	4.78	16,179	Big Horn River
9. Owl Creek Unit	245	3.49	855	S.F. Owl Creek
Subtotals	54,005		210,227	
B. Project Lands - Historic				
1. Ray Unit	9,898	5.32	52,657	Little Wind River and Tributaries
Ray Unit	28	4.21	118	Little Wind River and Tributaries
2. Coolidge Unit	7,829	4.95	38,753	Little Wind River and Tributaries
Coolidge Unit	200	5.00	1,001	Little Wind River and Tributaries
3. Sub Agency Unit	3,162	5.26	16,632	Little Wind River and Tributaries
Sub Agency Unit	306	5.00	1,531	Little Wind River and Tributaries
4. Dinwoody Bench Unit	5,496	12.06	66,281	Wind River and Tributaries
Dinwoody Bench Unit	492	4.18	2,056	Wind River and Tributaries
5. Wind River "A" Unit	1,118	12.06	13,483	Wind River
6. Johnstown Unit	654	6.94	4,539	Wind River
Johnstown Unit	190	5.00	951	Wind River
7. Lefthand Unit	2,148	6.90	14,821	Wind River

Description	Water Right Acreage (acres)	Average Annual Diversion (AF/acre)	Annual Diversion Requirement (acre-feet)	Source of Water Supply (description)
8. LeClair Unit	1,371	5.48	7,513	Wind River
9. Midvale Unit	569	5.58	3,175	Wind River
Subtotals	33,461		223,511	
TOTAL PROJECT LANDS	87,466		433,738	
2. NON-PROJECT LANDS				
A. Wind River Basin				
1. East Fork Wind River	310	5.06	1,568	E.F. Wind River and/or Tributaries
2. Dinwoody Creek	171	5.57	953	Dinwoody Creek and/or Tributaries
3. Meadow Creek	166	5.43	901	Meadow Creek and/or Tributaries
4. Meadow Creek	179	5.51	986	Meadow Creek and/or Tributaries
5. Meadow Creek	160	5.09	814	Meadow Creek and/or Tributaries
6. Dry (Pasup) Creek	1,977	5.31	10,498	Dry (Pasup) Creek and/or Tributaries
7. Dry (Pasup) Creek	56	5.20	291	Dry (Pasup) Creek and/or Tributaries
8. Dry (Pasup) Creek	115	5.06	581	Dry (Pasup) Creek and/or Tributaries
9. Crow Creek	2,927	5.31	15,542	Crow Creek and/or Tributaries
10. Crow Creek	36	5.40	194	Crow Creek and/or Tributaries
11. Crow Creek	154	5.29	815	Crow Creek and/or Tributaries
12. Dry Creek	183	5.54	1,014	Dry Creek and/or Tributaries
13. Dry Creek	4	5.57	22	Dry Creek and/or Tributaries
14. Willow Creek	60	5.57	334	Willow Creek and/or Tributaries
15. Willow Creek	7	5.06	35	Willow Creek and/or Tributaries
16. Bull Lake Creek	26	5.40	140	Bull Lake Creek and/or Tributaries
17. Bull Lake Creek	37	5.37	199	Bull Lake Creek and/or Tributaries

Description	Water Right Acreage (acres)	Average Annual Diversion (AF/acre)	Annual Diversion Requirement (acre-feet)	Source of Water Supply (description)
18. Main Stem Wind River	1,338	5.54	7,413	Wind River
19. Main Stem Wind River	487	5.77	2,810	Wind River
20. Main Stem Wind River	213	5.51	1,174	Wind River
Subtotals	8,606		46,284	
B. Little Wind River Basin				
1. N.F. Little Wind River	485	5.49	2,663	N.F. Little Wind River and/or Tributaries
2. N.F. Little Wind River	1,776	5.14	9,129	N.F. Little Wind River and/or Tributaries
3. N.F. Little Wind River	357	5.03	1,795	N.F. Little Wind River and/or Tributaries
4. S.F. Little Wind River	107	4.94	529	S.F. Little Wind River and/or Tributaries
5. S.F. Little Wind River	781	5.11	3,991	S.F. Little Wind River and/or Tributaries
6. S.F. Little Wind River	44	5.09	224	S.F. Little Wind River and/or Tributaries
7. Main Stem Little Wind River	1,191	5.94	7,075	Main Stem Little Wind River
8. Sage Creek	1,029	5.57	5,732	Sage Creek and/or Tributaries
9. Sage Creek	776	5.51	4,276	Sage Creek and/or Tributaries
10. Crooked Creek	69	5.26	363	Crooked Creek and/or Tributaries
11. Crooked Creek	3	5.57	17	Crooked Creek and/or Tributaries
12. Trout Creek	228	5.46	1,245	Trout Creek and/or Tributaries

Description	Water Right Acreage (acres)	Average Annual Diversion (AF/acre)	Annual Diversion Requirement (acre-feet)	Source of Water Supply (description)
13. Trout Creek	63	5.11	322	Trout Creek and/or Tributaries
14. Spring Creek	178	4.97	885	Spring Creek and/or Tributaries
15. Bighorn Draw	139	4.94	687	Bighorn Draw and/or Tributaries
16. Mill Creek	47	5.57	262	Mill Creek and/or Tributaries
Subtotals	7,273		39,195	
C. Big Horn River Basin				
1. Main Stem Big Horn River	126	5.94	749	Big Horn River
2. Cottonwood Creek	942	5.89	5,548	Cottonwood Creek and/or Tributaries
3. Muddy Creek	2,901	5.43	15,752	Muddy Creek and/or Tributaries
4. Muddy Creek	1,194	5.60	6,686	Muddy Creek and/or Tributaries
5. Muddy Creek	186	5.63	1,047	Muddy Creek and/or Tributaries
6. Five Mile Creek	518	5.57	2,885	Five Mile Creek and/or Tributaries
Subtotals	5,867		32,667	
D. Popo Agie River Basin				
1. N.F. Popo Agie River	422	5.40	2,279	N.F. Popo Agie and/or Tributaries
2. N.F. Popo Agie River	112	5.43	608	N.F. Popo Agie and/or Tributaries

Description	Water Right Acreage (acres)	Average Annual Diversion (AF/acre)	Annual Diversion Requirement (acre-feet)	Source of Water Supply (description)
3. Main Stem Popo Agie River	40	5.40	216	Main Stem Popo Agie River
4. Main Stem Popo Agie River	74	5.74	425	Main Stem Popo Agie River
Subtotals	648		3,528	
E. Owl Creek Basin				
1. S.F. Owl Creek	1,529	5.46	8,348	S.F. Owl Creek and/or Tributaries
2. S.F. Owl Creek	75	5.51	413	S.F. Owl Creek and/or Tributaries
3. S.F. Owl Creek	64	5.57	356	S.F. Owl Creek and/or Tributaries
4. Main Stem Owl Creek	434	5.40	2,343	Main Stem Owl Creek
5. Mud Creek	754	5.43	4,094	Mud Creek and/or Tributaries
6. Mud Creek	185	5.29	979	Mud Creek and/or Tributaries
7. Mud Creek	40	5.37	215	Mud Creek and/or Tributaries
Subtotals	3,081		16,748	
TOTAL NON-PROJECT	25,465		138,422	
TOTAL CLAIM	112,936 acres		572,160 acre-feet	

Section 2

LIVESTOCK WATER REQUIREMENTS

PRIORITY DATE: July 3, 1868

Description	Annual Water Requirement (acre-feet)	Sources of Water Supply (description)
1. Wind River/Big Horn River Basins	870	Wind and Big Horn Rivers and/or their Tributaries
2. Little Wind River Basin	870	Little Wind River and/or Tributaries
3. Popo Agie River	60	Popo Agie River and/or Tributaries
4. Owl and Red Canyon Creeks	930	Owl and Red Canyon Creeks and/or their Tributaries
TOTAL	2,730 acre-feet	

Section 3

MUNICIPAL WATER REQUIREMENTS

PRIORITY DATE: July 3, 1868

Service Area	Annual Water Requirement (acre-feet)	Source of Water Supply (description)
1. Riverton	39	Wind River
2. Fort Washakie	972	Little Wind River and/or Tributaries
3. Ethete	549	Little Wind River
4. Boulder Flat	56	Popo Agie River and/or Tributaries
5. Riverton	39	Groundwater
6. Arapahoe	331	Groundwater
7. Pavillion	4	Groundwater
8. Other Areas	236	Groundwater
TOTAL	2,226 acre-feet	

Section 4

INDUSTRIAL AND MINERAL DEVELOPMENT WATER REQUIREMENTS

PRIORITY DATE: July 3, 1868

Mineral	Use	Annual Diversion Requirement (acre-feet)	Source of Water Supply (description)
1. Oil	Secondary Recovery	5,550	Groundwater
2. Oil	Secondary Recovery	1,030	Groundwater/Wind River 1/
3. Natural Gas	Sweetening and Dehydrating Plant	6	Groundwater
4. Natural Gas	Sulfuric Acid Plant	95	Groundwater
5. Natural Gas	Anhydrous Ammonia Plant	4,250	Groundwater/Wind River 1/
6. Coal	In-Situ Gasification Plant	2,800	Groundwater
7. Coal	Dust Control/ Reclamation at Power Plant	25	Groundwater
8. Coal	150 MW Power Plant	2,490	Groundwater/Wind River 1/
9. Gypsum	Surface Reclamation for Mining	10	Groundwater
10. Gypsum	Wallboard Manufacturing Plant	300	Groundwater/Wind River 1/
11. Uranium	Dust Control/Incidental Purposes at Plant	15	Groundwater
12. Uranium	Uranium Processing Plant	475	Groundwater/Crow Creek 1/

1/ 9370 acre-feet of the mineral and industrial water requirements can be served from either surface or groundwater. The remaining requirements are to be furnished from groundwater.

Mineral	Use	Annual Diversion Requirement (acre-feet)	Source of Water Supply (description)
13. Phosphate	Minining Operation	5	Groundwater
14. Phosphate	Beneficiation/Wet Acit Processing	825	Groundwater/Wind River 2/
TOTALS		17,876 acre-feet	

ARTICLE III

It is further ORDERED, ADJUDGED and DECREED, that the United States has reserved, by virtue of the Treaty of July 3, 1868, and for the benefit of the Shoshone and Arapahoe Tribes, the right to prevent any person, having a priority date later than July 3, 1868, from diverting or attempting to divert any of the waters in the following reaches of the following streams as set out in Sections 1 and 2 of the Article. Provided further that said rights to prevent diversions or attempts to divert may be exercised by the United States or by the Shoshone and Arapahoe Tribes.

2/ 9370 acre-feet of the mineral and industrial water requirements can be served from either surface or groundwater. The remaining requirements are to be furnished from groundwater.

Section 1

PRIORITY DATE: July 3, 1868

AESTHETICS AND WILDLIFE FLOWS

Description	Annual Diversion Requirement (acre-feet)
1. All streams/creeks within aesthetics boundary. 3/	All Natural Flows
2. All natural lakes.	Water to Maintain Average Historic Lake Levels

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3/ All affected streams and creeks are depicted on United States Exhibit WRIR C-7. The requirement for the total natural flow within the aesthetics area is non-consumptive in nature.

Section 2

PRIORITY DATE: July 3, 1868

FISHERY FLOWS

Stream Reach 1 -- Wind River (above Dinwoody Creek)

	MMF (cfs)
January	173
February	172
March	176
April	258
May	320
June	320
July	320
August	320
September	320
October	320
November	246
December	199

Stream Reach 2 -- Wind River (between Dinwoody and Bull Lake Creeks)

	MMF (cfs)
January	201
February	200
March	207
April	284

Stream Reach 2 Continued	MMF (cfs)
May	500
June	500
July	500
August	500
September	500
October	444
November	302
December	239

Stream Reach 3 -- Wind River (between Bull Lake Creek and Diversion Dam)

	MMF (cfs)
January	254
February	249
March	258
April	371
May	500
June	500
July	500
August	500
September	500
October	500
November	365
December	291

Stream Reach 4 -- Wind River (between Diversion Dam and Little Wind River confluence -- two study sites)

	MMF (cfs)
January	256
February	250
March	260
April	325
May	325
June	325
July	325
August	325
September	325
October	325
November	325
December	293

Stream Reach 5 -- Wind River (below Little Wind River to boundary of Boysen Reservoir Withdrawal Area)

	MMF (cfs)
January	393
February	384
March	396
April	500
May	500
June	500
July	500
August	500
September	500
October	500

Stream Reach 5 Continued	MMF (cfs)
November	500
December	439

Stream Reach 6 -- Wind River (Wind River Canyon)

	MMF (cfs)
January	399
February	390
March	444
April	500
May	500
June	500
July	500
August	500
September	500
October	500
November	500
December	444

Stream Reach 7 -- East Fork Wind River (below Wiggins Fork)

	MMF (cfs)
January	45
February	43
March	45
April	95
May	207
June	207
July	207

Stream Reach 7 Continued	MMF (cfs)
August	207
September	123
October	82
November	56
December	49

Stream Reach 8 -- Bull Lake Creek (above Bull Lake)

	MMF (cfs)
January	29
February	31
March	29
April	47
May	215
June	215
July	215
August	215
September	180
October	83
November	45
December	33

Stream Reach 9 -- Bull Lake Creek (below Bull Lake)

	MMF (cfs)
January	30
February	33
March	31
April	50

Stream Reach 9 Continued	MMF (cfs)
May	255
June	255
July	255
August	255
September	178
October	76
November	41
December	32

Stream Reach 10 -- North Fork Little Wind River (below North Fork Canyon)

	MMF (cfs)
January	19
February	20
March	20
April	26
May	80
June	80
July	80
August	80
September	69
October	35
November	23
December	20

Stream Reach 11 -- South Fork Little Wind River (below Washakie Reservoir)

	MMF (cfs)
January	22
February	25
March	23
April	31
May	110
June	110
July	110
August	91
September	72
October	41
November	28
December	23

Stream Reach 12 -- Little Wind River (above Popo Agie River confluence)

	MMF (cfs)
January	49
February	51
March	51
April	71
May	75
June	75
July	75
August	75
September	75
October	75

Stream Reach 11 -- South Fork Little Wind River (below Washakie Reservoir)

	MMF (cfs)
January	22
February	25
March	23
April	31
May	110
June	110
July	110
August	91
September	72
October	41
November	28
December	23

Stream Reach 12 -- Little Wind River (above Popo Agie River confluence)

	MMF (cfs)
January	49
February	51
March	51
April	71
May	75
June	75
July	75
August	75
September	75
October	75

November	61
December	52

Stream Reach 13 -- North Fork Popo Agie River (below North Fork Canyon)

	MMF (cfs)
January	17
February	16
March	15
April	26
May	77
June	77
July	77
August	77
September	52
October	34
November	23
December	19

Stream Reach 14 -- Popo Agie River (below the North and Middle Forks and above Little Wind River confluence)

	MMF (cfs)
January	48
February	46
March	46
April	94
May	172
June	172
July	172

August	172
September	140

Stream Reach 14 Continued	MMF (cfs)
October	91
November	63
December	53

Stream Reach 15 -- Dinwoody Creek (below Dinwoody Lakes)

	MMF (cfs)
January	15
February	14
March	14
April	21
May	110
June	110
July	110
August	110
September	95
October	38
November	21
December	16

Stream Reach 16 -- Crow Creek (above Crow Creek Canyon)

	MMF (cfs)
January	3
February	3
March	3
April	6

May	12
June	12
July	12
Stream Reach 16 Continued	MMF (cfs)
August	12
September	7
October	5
November	4
December	3

ARTICLE IV

ADDITIONAL AGRICULTURAL USES FOR TRUST LANDS OUTSIDE THE STIPULATED BOUNDARIES OF THE WIND RIVER INDIAN RESERVATION 4/

It is further ORDERED, ADJUDICATED and DECREED that the United States, as trustee for the Shoshone and Arapahoe Tribes, has a reserved water right to divert waters in the amounts set out below as "Average Annual Diversion", with the priority dates set out below as "Reserved Right Priority Date"; said right, however, shall not be construed as an abrogation, limitation, condition, or impairment of the rights the United States or the Shoshone and Arapahoe Tribes have under State law to divert water in the amount authorized by State law and with the priority date set out in the column headed "State Awarded Priority Date".

4/ Boundary Stipulation attached hereto as Appendix 1.

SECTION 1

ARAPAHOE RANCH
MERRILL LAND PURCHASE
LANDS NORTH OF SOUTH FORK OF OWL CREEK

PRIORITY DATE: July 14, 1948

WATER SOURCE: South Fork of Owl Creek

DITCH NAME	PERMIT NO.	PROOF NO.	ACRES	STATE AWARDED PRIORITY DATE	RESERVED RIGHT PRIORITY DATE	AVERAGE ANNUAL DIVERSION (ACRE FEET)
Typer #4	11707	14032	64	05-16-1912	7-14-48	350
Riggs	6621	14024	27	06-20-1904	7-14-48	147
Typer #3	10719	N/A	9.4	None	7-14-48	50

SECTION 2

PADLOCK RANCH PURCHASE
LANDS NORTH OF MAINSTEM OF OWL CREEK

PRIORITY DATE: April 10, 1941

WATER SOURCE: Owl Creek

DITCH NAME	PERMIT NO.	PROOF NO.	ACRES	STATE AWARDED PRIORITY DATE	RESERVE RIGHTY PRIORITY DATE	AVERAGE ANNUAL DIVERSION (ACRE FEET)
Sliney & Mikkelson	Terr.	3526	122.63	10-1884	4-10-41	662
Sliney & Mikkelson	Terr.	3526	32.0	10-1884	4-10-41	173
Sliney & Mikkelson	Terr.	3527	222.63	10-1884	4-10-41	1202
Padlock	Terr.	3534	224.35	06-1887	4-10-41	1212
Dewitt	2306	6271	17.0	10-04-1899	4-10-41	92
Sliney No. 1	4038	8350	160.0	07-11-1902	4-10-41	864
Sliney No. 1	4038	8351	160.0	07-11-1902	4-10-41	864
Rothwell Enl. of Sliney No. 1	2125E	15024	85.0	09-17-1909	4-10-41	459
Rothwell Enl. of Sliney No. 1	2125E	15024	233.0	09-17-1909	4-10-41	1258
Padlock	Terr.	3533	252.0	06-1887	4-10-41	1361
Padlock	Terr.	3534	41.0	06-1887	4-10-41	221
Padlock	Terr.	3534	285.44	06-1887	4-10-41	1541
Padlock	None	None	24.0	None	4-10-41	130
Sliney No. 1	None	None	12.0	None	4-10-41	65
Padlock	None	None	5.9	None	4-10-41	32
Padlock	None	None	43.1	None	4-10-41	231
Sliney No. 1	None	None	44.0	None	4-10-41	236

ARTICLE V

Any water rights listed herein may be exercised only for beneficial uses.

ARTICLE VI

The foregoing references to a quantity of water necessary to supply the diversion requirements for irrigation, municipal and industrial, mineral, and livestock, shall constitute the means of determining the quantity of Indian water rights but shall not constitute a restriction to those uses indicated above. If all or part of the Indian water rights decreed herein are used other than for the uses indicated above, the total diversion shall not exceed the diversion requirements set forth above.

ARTICLE VII

In the event that there is insufficient water in the Big Horn River system and its tributaries to fulfill the Indian water rights set forth in Article II, Sections 1-6 and Article III, Section 1, and Article IV, Section 1, of this decree, the available water supply shall be applied to such of those Indian water rights as can be served pursuant to determination of the Joint Business Council of the Shoshone and Arapahoe Tribes or its designated representative, in consultation with the Secretary of the Interior or his designated representative.

ARTICLE VIII

In the event that any additional land within the stipulated reservation boundaries, (stipulation attached hereto as Appendix 1), not held in trust as of February 19, 1982, (the date of the close of evidence in this trial) but which is subsequently reacquired in trust by the United States for the benefit of the Shoshone and Arapahoe Indian Tribes, such land upon proof that it meets any of the bases upon which reserved water rights have been determined in this case shall be added to the decreed totals listed above.

ARTICLE IX

Any of the parties to this adjudication may apply at the foot of this decree for its amendment or for further relief. The court retains jurisdiction of this suit for the purpose of any order, directions, or modification of the decree, or any supplementary decree, that may at any time be deemed proper in relation to the subject matter in controversy. Nothing herein shall abridge the rights of the United States, the Shoshone or Arapahoe Indian Tribes that they may have under applicable federal law.

APPENDIX 1

IN THE DISTRICT COURT OF THE

FIFTH JUDICIAL DISTRICT

STATE OF WYOMING)
) ss:
COUNTY OF WASHAKIE)

IN RE:

THE GENERAL ADJUDICATION OF)
ALL RIGHTS TO USE WATER IN)
THE BIG HORN RIVER SYSTEM) Civil No. 4993
AND ALL OTHER SOURCES,)
STATE OF WYOMING)

STIPULATION CONCERNING THE BOUNDARIES OF
THE WIND RIVER INDIAN RESERVATION

The United States of America, State of Wyoming and Shoshone and Arapahoe Indian Tribes move the Special Master to enter an order approving the following stipulation for the purposes of this litigation only:

For the purposes of determining the reserved or other rights to the use of water, if any, which may exist with respect to the Wind River Indian Reservation, the exterior boundaries of the Wind River Indian Reservation are as set forth in the United States Statement of Geographic Boundaries filed herein, and are agreed to include the following-described lands:

That part of the Wind River Meridian more particularly described as follows:

Sections 1 through 36 in the following Townships and Ranges:

T. 1N R. 1E
T. 1N R. 2E
T. 1N R. 3E
T. 1N R. 4E
T. 1N R. 5E
T. 2N R. 1E
T. 2N R. 2E
T. 2N R. 3E
T. 2N R. 4E

T. 2N R. 5E
T. 3N R. 1E
T. 3N R. 2E
T. 3N R. 3E
T. 3N R. 4E
T. 3N R. 5E
T. 4N R. 1E
T. 4N R. 2E
T. 4N R. 3E
T. 4N R. 4E
T. 4N R. 5E
T. 5N R. 1E
T. 5N R. 2E
T. 5N R. 3E
T. 5N R. 4E
T. 5N R. 5E
T. 6N R. 1E
T. 6N R. 2E
T. 6N R. 3E
T. 6N R. 4E
T. 6N R. 5E
T. 7N R. 1E
T. 7N R. 2E
T. 7N R. 3E
T. 8N R. 2E
T. 1S R. 1E
T. 1S R. 2E
T. 1S R. 3E
T. 1S R. 4E
T. 1S R. 5E
T. 1S R. 1W
T. 1S R. 2W
T. 1S R. 3W
T. 1S R. 4W
T. 1N R. 1W
T. 1N R. 2W
T. 1N R. 3W
T. 1N R. 4W
T. 1N R. 5W
T. 2N R. 1W
T. 2N R. 2W
T. 2N R. 3W
T. 2N R. 4W
T. 2N R. 5W
T. 3N R. 1W
T. 3N R. 2W
T. 3N R. 3W
T. 3N R. 4W
T. 3N R. 5W
T. 4N R. 1W
T. 4N R. 2W
T. 4N R. 3W
T. 4N R. 4W
T. 4N R. 5W
T. 5N R. 1W
T. 5N R. 2W
T. 5N R. 3W
T. 5N R. 4W
T. 5N R. 5W
T. 6N R. 1W
T. 6N R. 2W
T. 6N R. 3W
T. 6N R. 4W
T. 6N R. 5W
T. 7N R. 1W
T. 7N R. 2W
T. 7N R. 3W
T. 7N R. 4W

And portions of the following Townships and Ranges:

T. 1S R. 5W

Sections 1 - 28, 34, 35, 36 and portions of Sections 29, 30, 32 and 33 (unsurveyed).

T. 8N R. 4W

SW¼ Section 1
S½ SE¼ Section 1
NW¼ SE¼ Section 1
SW¼ NW¼ Section 1
Lots 1 through 4 Section 1

And, all of Sections 2 through 36.

T. 2S R. 2E

Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 16, 17, 18

And,

NW¼ Section 11
W½ NE¼ Section 11
Lot 4
W½ SW¼ Section 11
NE¼ SW¼ Section 11
Lots 1, 2 and 3 Section 11
Lots 1 - 5 Section 12
Lots 1 - 5 Section 14
N½ Section 15
N½ S½ Section 15
S½ SW¼ Section 15
Lots 1 and 2 Section 15
NE¼ Section 19
E½ NW¼ Section 19
E½ SW¼ Section 19
Lots 1 - 8 Section 19
N½ Section 20
Lots 1 - 5 Section 20
NW¼ Section 21
NE¼ NE¼ Section 21
W½ NE¼ Section 21
Lots 1 - 5 Section 21
NW¼ NW¼ Section 22
Lots 1 - 4 Section 22
Lots 1 - 5 Section 30

T. 2S R. 1E

Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 24

And,

E½ Section 14
Lots 1 - 8 Section 15
Lots 1 - 6 Section 16
N½ NE¼ Section 16
N½ NW¼ Section 16
N½ Section 17
N½ SE¼ Section 17
NE¼ SW¼ Section 17
Lots 1 - 4 Section 17
N½ N½ Section 18
Lots 2 - 5 Section 18
Lot 1 Section 20
E½ NW¼ and NW¼ NW¼ Section 14
Lots 1 - 3 Section 14
NE¼ NE¼ Section 23
Lots 1 - 4 Section 23
E½ NW¼ Section 25
W½ NE¼ Section 25
Lots 1 - 7 Section 25
Lots 1 - 2 Section 26
NW¼ NW¼ Section 25

T. 2S R. 3E

Sections 1, 2, 3, 4, 5, 6

And,

Lots 1 - 5 Section 7
Lots 1 - 4 Section 8
Lots 1 - 4 Section 9
Lots 1 - 4 Section 10
Lots 1 - 4 Section 11
Lots 1 - 4 Section 12

T. 2S R. 4E

Sections 1 - 6

Lots 1 - 4 Sections 7 through 12

T. 2S R. 5E

Sections 1 - 6

Lots 1 - 4 Sections 7 through 12

T. 1S R. 6E

Sections 4 - 9, 16 - 21, 28 - 33,

And,

W½ SW¼ Section 3
SW¼ NW¼ Section 3
Lots 1 - 5 Section 3
W½ W½ Sections 10, 15, 22, 27, 34
Lots 1 - 4 Sections 10, 15, 22, 27, 34

T. 2S R. 6E

Sections 4, 5, 6

And,

W½ W½ Section 3
Lots 1 - 4 Section 3
Lots 1 - 4 Sections 7, 8, 9
Lots 1 - 2 Section 10

T. 2S R. 5W

Sections 1, 2, 11, 12, 13

And,

NW¼ Section 3
SE¼ Section 3
W½ NE¼ Section 3
E½ SW¼ Section 3
Lots 1 - 4 Section 3
NE¼ NE¼ Section 4
Lots 1 and 2 Section 4
NE¼ Section 10
N½ SE¼ Section 10
SE¼ SE¼ Section 10
NE¼ NW¼ Section 10
Lots 1 - 5 Section 10
E½ NE¼ Section 15
NE¼ SE¼ Section 15
Lots 1 - 4 Section 15
E½ Section 14
E½ W½ Section 14
W½ NW¼ Section 14
NW¼ SW¼ Section 14
Lot 1 Section 14
NE¼ Section 23
E½ NW¼ Section 23
NE¼ SW¼ Section 23
N½ SE¼ Section 23
Lots 1 - 7 Section 23
N½ Section 24
N½ S½ Section 24
Lots 1 - 4 Section 24

T. 2S R. 3W

Sections 1 - 18

And,

NE¼ Section 19
E½ NW¼ Section 19
NE¼ SW¼ Section 19
N½ SE¼ Section 19
Lots 1 - 7 Section 19
N½ Sections 20 - 23
N½ S½ Sections 20 and 23
Lots 1 - 4 Sections 20 and 23
Lots 1 - 8 Sections 21 and 22
Lots 1 - 7 Section 24
NW¼ Section 24
W½ NE¼ Section 24
N½ SW¼ Section 24
NW¼ SE¼ Section 24
Lots 1 - 7 Section 24

T. 2S R. 4W

Section 1 - 18

NE¼ Section 19
N½ SE¼ Section 19
E½ NW¼ Section 19
NE¼ SW¼ Section 19
Lots 1 - 7 Section 19
N½ Sections 20 - 24
N½ S½ Sections 20 - 24
Lots 1 - 4 Sections 20 - 24

T. 2S R. 1W

Sections 1 - 12, 16, 17, 18

And,

N½ NE¼ Section 13
Lots 1 - 6 Section 13
N½ N½ Section 14
SW¼ NW¼ Section 14
Lots 1 - 4 Section 14
N½ Section 15
N½ SW¼ Section 15
SW¼ SW¼ Section 15
Lots 1 - 4 Section 15
NE¼ Section 19
N½ SE¼ Section 19
E½ NW¼ Section 19
NE¼ SW¼ Section 19
Lots 1 - 7 Section 19
N½ Section 20
N½ S½ Section 20
Lots 1 - 4 Section 20
N½ Section 21
NW¼ SW¼ Section 21
Lots 1 - 4 Section 21
NW¼ NW¼ Section 22
Lots 1, 2, 3 Section 22

T. 2S R. 2W

Sections 1 - 18

And,

NE¼ Section 19
N½ SE¼ Section 19
E½ NW¼ Section 19
NE¼ SW¼ Section 19
Lots 1 - 7 Section 19
N½ Sections 20 - 24
N½ S½ Sections 20 - 24
Lots 1 - 4 Sections 20 - 24

T. 7N R. 5W

Sections 1 - 4, 8 - 36

And,

S½ Section 5
S½ NE¼ Section 5
SE¼ NW¼ Section 5
Lots 1, 2, 3 and 4 Section 5

And,

Lots 1, 2, 3 Section 6
SE¼ SE¼ Section 6
E½ Section 7
E½ SW¼ Section 7
SE¼ NW¼ Section 7

And,

Lots 1 - 4 Section 7

T. 1S R. 6W Note: This Township was unsurveyed except that portion inside the Reservation which is shown on the exterior boundary plat.

(Unsurveyed) - Sections 1 - 3, 10 - 15, 23 - 25

T. 9N R. 5W

Lots 1 and 2 Sections 25 and 35
Lots 1 - 3 Section 36
SE¼ Section 36
E½ NE¼ Section 36
SW¼ NE¼ Section 36
E½ SW¼ Section 36
SW¼ SW¼ Section 36

T. 1N R. 6W (This Township is unsurveyed except for the western boundary of the Reservation and portion of the southern boundary and south 3 miles of the eastern boundary of the Township.)

(Unsurveyed) - Sections 1, 2, 3, 10 - 15, 22 - 27, 34 - 36

T. 2N R. 6W (The only portion of this Township that is surveyed is approximately the NE¼.)

(Unsurveyed) - Sections 1 - 3, 10 - 15, 22 - 27, 34 - 36

T. 3N R. 6W

Sections 1, 2, 11 - 14, 23 - 26, 35, 36

E½ Sections 3, 10, 15, 22, 27, 34
Lots 1 - 4 Sections 10, 15, 22, 27, 34
Lots 1 - 6 Section 3

T. 4N R. 6W

Sections 11 - 14, 23 - 26, 35, 36

E½ Sections 10, 15, 22, 27, 34
Lots 1 - 4 Sections 10, 15, 22, 27, 34
SE¼ Section 3
S½ NE¼ Section 3
Lots 1 - 6 Section 3

S½ Section 2
S½ N½ Section 2
Lots 1 - 4 Section 2
SW¼ Section 1
S½ NW¼ Section 1
W½ SE¼ Section 1
SW¼ NE¼ Section 1
Lots 1 - 7 Section 1

T. 8N R. 5W

Sections 1, 11, 12, 13, 14, 15, 22, 23, 24, 25, 26, 27, 33, 34, 35, 36

And,

S½ Section 2
S½ NE¼ Section 2
SE¼ NW¼ Section 2
Lots 1 - 4 Section 2
SE¼ SE¼ Section 3
Lots 1 and 2 Section 3
SE¼ SE¼ Section 9
Lots 1 and 2 Section 9
S½ Section 10
NE¼ Section 10
SE¼ NW¼ Section 10
Lots 1 and 2 Section 10
E½ Sections 16, 21, 28, 32
Lots 1 - 4 Sections 16 and 21
E½ SW¼ Section 16
SE¼ NW¼ Section 16
SW¼ Section 28
SE¼ NW¼ Section 28
Lots 1 and 2 Section 28 and 29
SE¼ SE¼ Section 29
Lots 1 - 4 Section 32

T. 5N R. 6W

Sections 1, 2, 11 - 14, 23 - 26, 35, 36

E½ E½ Sections 10, 15, 22, 27, 34
Lots 1 - 4 Sections 10, 15, 22, 27, 34
E½ SE¼ Section 3
Lots 1 - 9 Section 3

T. 6N R. 6W

Sections 1, 2, 11 - 14, 23 - 26, 35, 36, 15

And,

E½ Sections 10, 22, 27, 34
Lots 1 - 6 Section 3
SE¼ Section 3
S½ NE¼ Section 3
SE¼ SW¼ Section 10
Lots 1 - 4 Section 10
Lots 1 - 3 Section 16
NW¼ Section 22
E½ SW¼ Section 22
NW¼ SW¼ Section 22

Lot 1 Section 22
Lots 1, 2, 3 Section 21
SE¼ NW¼ Section 27
SE¼ SW¼ Section 27
Lots 1 - 4 Section 27
NE¼ NW¼ Section 34
NE¼ SW¼ Section 34
Lots 1 - 4 Section 34
Lot 1 Section 9

T. 7N R. 6W

Sections 13, 23 - 26, 35, 36

SE¼ Section 12
S½ SW¼ Section 12
Lots 1 - 4 Section 12
Lot 1 Section 11
SE¼ Section 14
NE¼ NE¼ Section 14
S½ NE¼ Section 14
NE¼ SW¼ Section 14
S½ SW¼ Section 14
Lots 1 - 4 Section 14
SE¼ SE¼ Section 22
Lots 1 - 4 Section 22
E½ E½ Sections 27, 34
Lots 1, 2 Section 15
Lots 1 - 4 Sections 27, 34
W½ SE¼ Section 34

T. 8N R. 1W

Sections 32 - 36, 23 - 28

S½ and NE¼ Section 22
S½ NW¼ Section 22
NE¼ NW¼ Section 22
Lot 1 Section 22
Lots 1 and 2 Section 13
Lots 1, 2, 3 Section 14
Lots 1, 2 Section 15
S½ SE¼ Section 21
NE¼ SE¼ Section 21
SE¼ SW¼ Section 21
Lots 1 - 5 Section 21
Lot 1 Section 20
SE¼ Sections 29 and 31
E½ SW¼ Sections 29 and 31
NE¼ NE¼ Sections 29 and 31
S½ NE¼ Sections 29 and 31
SW¼ SW¼ Section 29
Lots 1, 3 Section 29
Lots 1 - 4 Section 31
NW¼ NE¼ Section 31
SE¼ SE¼ Section 30
Lots 1, 2 Section 30

T. 8N R. 2W

Lots 1 and 2 Section 30
Lots 1 - 6 Section 31
SE¼ Section 31
S½ NE¼ Section 31
E½ W½ Section 31
S½ Section 32
S½ NW¼ Section 32
Lots 1 - 4 Sections 32, 33, 34, 35, 36
S½ S½ Sections 33 and 36
SW¼ SW¼ Section 34
S½ SE¼ Section 35

T. 8N R. 4E

Sections 14 - 23, 26 - 35, 7

Lots 1 and 2 Sections 12, 13, 24, 25, 36
S½ S½ Section 11
NW¼ SW¼ and SW¼ NW¼ Section 11
Lots 1 - 4 Sections 10, 11
S½ and SW¼ NW¼ Section 10
S½ and SE¼ NW¼ Section 9
Lots 1 - 4 Section 9
S½ and S½ NW¼ Section 8
Lots 1 - 4 Section 8
Lots 1 and 2 Section 5
Lots 1 - 4 Section 6

T. 7N R. 5E

Sections 19 - 36

Lots 1 - 4 Sections 13 - 18

T. 1N. R. 6E

Sections 4 - 19, 16 - 21, 28 - 33

Lots 1 - 4 Sections 10, 15, 22, 27, 34
W½ W½ Sections 10, 15, 22, 27, 34
W½ SW¼ and SW¼ NW¼ Section 3
Lots 1 - 5 Section 3

T. 2N R. 6E

Sections 4 - 9, 16 - 21, 28 - 33

W½ W½ Sections 10, 15, 22, 27, 34
Lots 1 - 4 Sections 10, 15, 22, 27, 34
W½ SW¼ and SW¼ NW¼ Section 3
Lots 1 - 5 Section 3

T. 3N R. 6E

Sections 4 - 9, 16 - 21, 28 - 33

W½ W½ Sections 10, 15, 22, 27, 34
Lots 1 - 4 Sections 10, 15, 22, 27, 34
W½ SW¼ and SW¼ NW¼ Section 3
Lots 1 - 5 Section 3

T. 4N R. 6E

Sections 4 - 9, 16 - 21, 28 - 33

W½ W½ Sections 10, 15, 22, 27, 34
Lots 1 - 4 Sections 10, 15, 22, 27, 34
W½ SW¼ and SW¼ NW¼ Section 3
Lots 1 - 5 Section 3

T. 8N R. 3E

Sections 3 - 36

And, S½ SW¼ Section 1
Lots 1 - 6 Section 1
S½ Section 2
S½ NW¼ Section 2
Lots 1 - 4 Section 2

T. 9N R. 3E

Sections 31 and 32

S½ SW¼ Section 29
Lots 1 - 5 Section 29
Lots 1 - 4 Section 28
SW¼ SE¼ Section 29
S½ SE¼ Section 30
SE¼ SW¼ Section 30
Lots 1 - 5 Section 30
SW¼ and S½ NW¼ Section 33
W½ SE¼ Section 33
SW¼ NE¼ Section 33
Lots 1 - 5 Section 33
SE¼ SE¼ Section 33
SW¼ SW¼ Section 34
Lots 1 - 4 Section 34
Lot 1 Section 35

T. 8N R. 1E

Sections 12 - 14, 19 - 36

And, Lots 1 - 5 Section 2
S½ Section 11
E½ NE¼ and SW¼ NE¼ Section 11
SE¼ NW¼ Section 11
Lots 1 - 3 Section 11
E½ and SW¼ of the SE¼ Section 10
SE¼ SW¼ Section 10

Lots 1 - 4 Section 10
S½ S½ and N½ SE¼ Section 16
SE¼ NE¼ Section 16
Lots 1 - 4 Section 16
S½ SE¼ Section 17
Lots 1 - 4 Section 17
Section 18 unsurveyed portion
S½, S½ NE¼, SE¼ NW¼ Section 1
Lots 1 - 5 Section 1
E½, SW¼, S½ NW¼, NE¼ NW¼ Section 15
Lot 1 Section 15

T. 9N R. 1E

SE¼ SW¼ Section 36
S½ SE¼ Section 36
Lots 1 - 4 Section 36
Lot 1 Section 35

T. 9N R. 2E

Section 36

And,

SE¼ and E½ and SW¼ of the SW¼ Section 25
Lots 1 - 4 Section 25
NE¼ and SE¼ and SW¼ Section 35
SE¼ NW¼ Section 35
Lots 1 - 3 Section 35
Lots 1 and 2 Section 26
SE¼ and E½ SW¼ Section 34
SW¼ SW¼ Section 34
Lots 1 - 5 Section 34
S½ S½ Section 33
Lots 1 - 4 Section 33
S½ S½ Section 31 and 32
Lots 1 - 4 Section 32
Lots 1 - 5 Section 31
NW¼ SW¼ Section 31

T. 9N R. 4W

Sections 21, 27 - 29, 31 - 34

Lot 1 Sections 15 and 36
Lots 1 - 3 Section 16
SW¼ SW¼ Section 16
Lots 1 and 2 Sections 17 and 19
Lots 1 - 3 Section 20
SE¼ and the S½ and NE¼ of the NE¼ and the E½ SW¼, and the SW¼ SW¼ Section 20
Lots 1 - 4 Section 22
SW¼ and the SW¼ SE¼ Section 22
W½ and SE¼ of the NW¼ Section 22
Lots 1 - 4 Section 26
SW¼ SW¼ Section 26
Lots 1 - 5 Section 30

E½ and SW¼ of the NE¼ Section 30
E½ of the SW¼ and W½ SE¼ Section 30
Lots 1 - 4 Section 35
SW¼ and the SW¼ SE¼ Section 35
W½ and SE¼ of the NW¼ Section 35
SE¼ Section 30

T. 8N R. 3W

Sections 16 - 22, 26 - 36

Lot 1 Sections 6 and 10
Lots 1 - 6 Section 7
SE¼ Section 7
S½ NE¼ Section 7
E½ SW¼ Section 7
E½ NW¼ Section 7
S½ Section 8
SE¼ NW¼ Section 8
Lots 1 - 4 Sections 8, 9
SW¼ Section 9
W½ SE¼ and SE¼ SE¼ Section 9
Lots 1 - 4 Section 15
SW¼ Section 15
SW¼ NW¼, W½ SE¼ Section 15
SE¼ SE¼ Section 15
Lots 1 and 2 Sections 14 and 24
Lots 1, 2, 3 Sections 23 and 25
SW¼ Section 23
W½ and SE¼ of the NW¼ and W½ and SE¼ of the SE¼ Section 23
SW¼ Section 25
W½ and SE¼ of the NW¼ and W½ and SE¼ of the SE¼ Section 25

T. 5N R. 6E

Sections 4 - 9, 16 - 21, 28 - 33

Lots 1 - 3 Section 3
Lots 1 - 4 Sections 10, 15, 22
Lots 1, 2, 5 and 6, Section 27
Lots 2, 3, 6 and 7, Section 34

T. 6N R. 6E

Unsurveyed Sections: 4, 5, N½ Section 8 and NW¼ Section 9

Sections 6, 7, 16 - 21, 28 - 33

S½ Sections 8 and 9
Lots 1 - 4 Sections 3, 10, 22, 27, 34
Lots 1 - 7 Section 15
NE¼ Section 9

T. 7N R. 6E

Sections 19 - 21, 28 - 33

Lots 1 - 4 Sections 16, 17, 18, 22, 27, 34
Lot 1 Section 15

T. 7N R. 4E

Sections 2 - 11, 14 - 36
Lots 1 and 2 Sections 1 and 12
Lots 1 - 5 Section 13
SW¼ SW¼ Section 13

The parties reserve their rights to challenge the validity, priority date, purposes, quantity of water, and any other characteristic of any water rights which may be claimed in the above-described area.

This stipulation shall not affect the jurisdiction of any parties over lands within the exterior boundaries of the Reservation.

AGREED this _____ day of April, 1980.

For the United States:

/s/ Regina L. Sleater
Regina L. Sleater
U.S. Department of Justice
Land & Natural Resources Division
Washington, D.C. 20530

/s/ Tom W. Echohawk
Tom W. Echohawk
U.S. Department of Justice
Land & Natural Resources Division
Washington, D.C. 20530

/s/ Charles E. Graves
Charles E. Graves
U.S. Attorney
Cheyenne, Wyoming 82001

For the Shoshone and Arapahoe Indian Tribes:

/s/ Harry R. Sachse
Harry R. Sachse
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Washington, D.C. 20036

/s/ R. Anthony Rogers
R. Anthony Rogers
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/s/ William R. Thomson
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For the State of Wyoming:

/s/ Jack D. Palma, II
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/s/ James L. Merrill
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Attorney General
State of Wyoming
Yegge, Hall & Evans
2900 Energy Center One
717 Seventeenth Street
Denver, Colorado 80202

IN THE DISTRICT COURT OF THE

FIFTH JUDICIAL DISTRICT

STATE OF WYOMING)
) ss:
COUNTY OF WASHAKIE)

IN RE:

THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING

Civil No. 4993

ORDER

The foregoing stipulation is hereby approved and adopted as the order of this Court.

DONE this _____ day of April, 1980.

Teno Roncalio
Special Master

U.S. GOVERNMENT PRINTING OFFICE 1982-0- 370-929/8163

IN THE DISTRICT COURT OF THE

FIFTH JUDICIAL DISTRICT

STATE OF WYOMING

IN RE: THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING

CIVIL NO. 4993

FILED

4/14 1982

Margaret V. Hampton CLERK

DEPUTY

CERTIFICATE OF SERVICE

I certify that a copy of the foregoing United States' Proposed Findings of Fact, Conclusions of Law, Brief in Support Thereof, and Proposed Interlocutory Decree was served on all counsel of record and pro se defendants this 7th day of April, 1981.

Tom W. Echohawk

TOM W. ECHOHAWK
Attorney, Department of Justice
Denver, Colorado